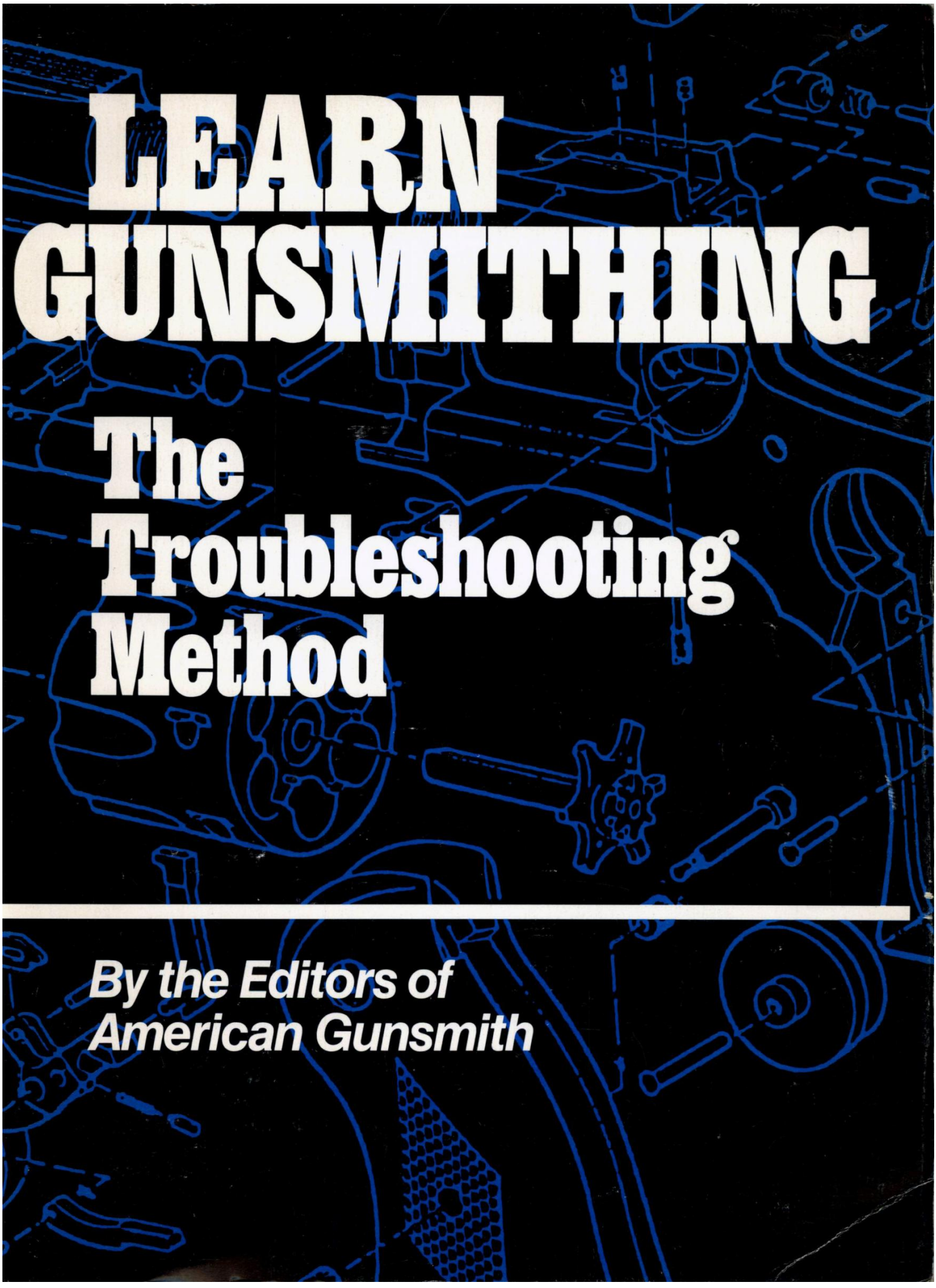


LEARN GUNSMITHING

The Troubleshooting Method

By the Editors of American Gunsmith

Learn Gunsmithing

The Troubleshooting Method

By
American Gunsmith Staff

A. G. Media Inc.
75 Holly Hill Lane
Box 2626
Greenwich, Connecticut 06836-2626

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Foreword

Sooner or later, almost every shooter becomes intrigued by the mechanics of firearms and the methods of repairing, improving, customizing, or altering them. A few of these gun buffs eventually become professional gunsmiths, while most simply improve their personal firearms — and their shooting. Whether your goal is to be an enthusiast or professional, this book will be a valuable addition to your workshop library.

To repair firearms efficiently and keep them in good condition, a gunsmith must have a thorough knowledge of "troubleshooting" — the techniques of determining the cause of any problem and correcting it without wasting time or using unnecessary new parts. Troubleshooting covers an enormous range of problems, from replacing a mainspring in a revolver to diagnosing why a repeating shotgun jams or a rifle fails to shoot accurately.

It's a systematic and methodical approach that's easy to master — especially with a book like this as a guide. The *American Gunsmith* staff covers the common problems encountered with every type of sporting firearm, and they provide unique troubleshooting charts to speed up the diagnosis and remedy.

Although this book is intended primarily for home gunsmiths, it will be an extremely helpful desk reference for professionals as well. Apprentice gunsmiths will also find the material valuable when used with other textbooks. In fact, it will be a useful manual for anyone who is interested in guns and shooting.

The Publisher

Chapter 1 - Introduction

Most firearms manufactured in the United States arc designed and built to last a lifetime, but all of them are subject to certain common malfunctions that will occur from time-to-time. Worn and broken parts will need to be replaced, trigger assemblies will need adjusting, headspace will need correcting, worn finishes will be renewed, and a host of other adjustments. In every case, before a gun can be repaired, the problem must first be determined; then a definite plan must be followed to do the actual repair. Finding out exactly what is wrong with a malfunctioning gun is known as troubleshooting, and troubleshooting firearms is what this book is all about. Consequently, the term "troubleshooting" as used in this book covers the investigation, analysis, and corrective action required to eliminate faults in the operation of firearms. The many troubleshooting charts found in these pages give steps for correcting most problems in firearms of all types. The charts are also meant to stimulate a train of thought and indicate a work procedure directed toward the source of trouble. To use them, find the complaint on the left side of the charts, then read across to the right for probable causes; continue across to the right for the proper corrective action.

Think before acting. Study the problem thoroughly, then ask yourself these questions:

- What were the warning signs preceding the trouble?
- What previous repair and maintenance work has been done?
- Has similar trouble occurred before?
- If the firearm still shoots, is it safe to continue shooting it before further testing?
- Have other guns of the same make and model been known to give similar problems, or is this the first occurrence? If the answer to this question is "yes," check your conclusions from the other models.

The answers to these questions can usually be obtained by:

- Questioning the owner, if the firearm belongs to someone else.
- Taking time to think the problem through.
- Looking for additional symptoms.
- Consulting the troubleshooting charts.
- Checking the simplest things first
- Checking parts in the gun against the parts pictured in the exploded views or parts list available from manufacturers.
- Checking with gauges and calibrated instruments.
- Double-checking all conclusions before disassembly of the gun or components.

The source of many problems can be traced not to one part alone but to the relationship of one part with another. For instance, improper feeding in a tubular-magazine rifle may not be caused by a weak magazine-tube spring but by a dented tube that prevents the spring from functioning properly. Too often, firearms are completely disassembled in the search for the cause of a complaint and all evidence is destroyed during disassembly. Check again to be certain an easy solution has not been overlooked.

After a mechanical failure has been corrected in any firearm, be sure to analyze what caused it so the same failure will not be repeated. Failure to extract a cartridge from the chamber may be corrected by replacing a broken extractor, but something caused it to break. Further investigation may reveal that a corroded chamber caused extremely hard extraction which eventually broke it. A careful polishing of the chamber would prevent the extractor from breaking again in the near future.

Basic Considerations

A common problem is not being able to correctly reassemble a firearm once it has been disassembled. Professional gunsmiths all over the country have had the experience of reassembling a customer's gun that was brought into the shop in paper bags and cigar boxes after the customer tried to "fix it up a bit" or thoroughly clean it. The customer probably had little trouble getting the gun apart, but putting it back together in the proper sequence was another matter. To compound the situation, the professional gunsmith often finds that some of the parts are missing (probably under the cushion of the owner's favorite chair); or screw heads have been badly marred and some parts are damaged beyond repair due to use of improper tools and/or procedures during disassembly. In fact, many professional gunsmiths make a good living from correcting amateur's mistakes.

The exploded views (Fig. 1-1), supplemental drawings, (Fig. 1-2) and extensive explanations of how guns are disassembled and assembled will help eliminate many of the problems. However, this material will not automatically make a professional gunsmith out of anyone. Some of the operations described should be done only by a professional who has the proper tools and experience.

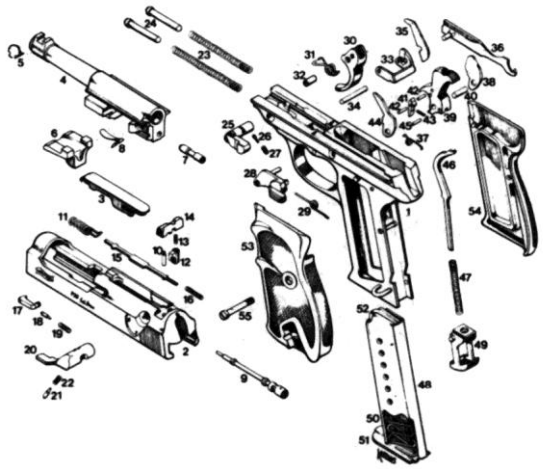


Figure 1-1: Exploded views greatly simplify the assembly/disassembly process. Collect all you can find.

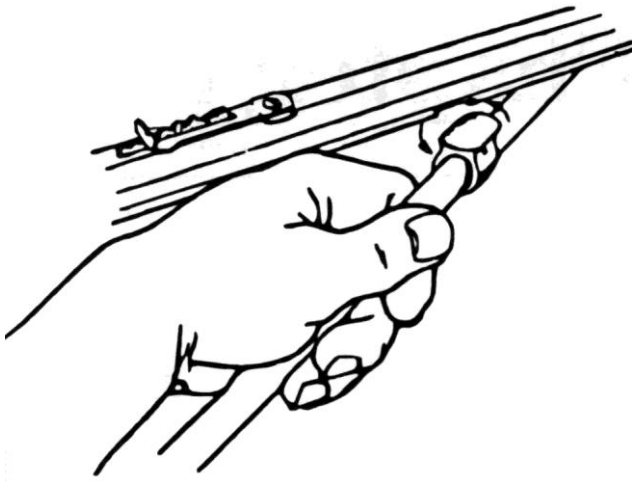


Figure 1-2: Firearm manufacturers sometimes furnish supplemental drawings to accompany exploded views, especially those procedures requiring special attention.

Visual Inspection

After disassembling a firearm and all parts have been given a thorough cleaning, carefully examine all internal parts for wear. This can save much disappointment later when you or a customer are using the gun in the field. Once all parts are thoroughly clean, examine the bore with a bore light. Is the barrel pitted? Should it be lapped, relined, or rebored? What is the general condition of the rifling or shotgun bore and other parts? Examine each smaller part under a magnifying glass. Look for hairline cracks, obvious breaks and excessive wear. If any are found, now is the time to replace or repair the part — not when you or your customer has lined up a big trophy animal and the gun fails.

The following is a summary of the initial inspection prior to actually performing any repair work:

- Look through the bore using a bore light to check for obstructions, bad pits, condition of rifling, excessive wear, or bulges. Examine the chamber for rough spots and for possible deformation of the extractor slots cut in the barrel. Also notice if there is any grime or debris that might prevent the gun from functioning properly.
- Check the firing-pin nose in the bolt for proper shape. If it's smooth, it may be worn, but not broken. A jagged or uneven surface indicates that the pin has been broken. See Fig. 1-3.
- Continue the visual inspection, checking all bearing surfaces for burrs and cracks — especially around the locking mechanism.
- Inspect the gunstock for cracks and loose-fitting areas where metal and wood join.
- While you're at it, check the swivels, sling, buttplate, etc.
- Finally, check the overall finish (wood and metal surfaces). You can then recommend touch-up work on the gun or a complete face lift.

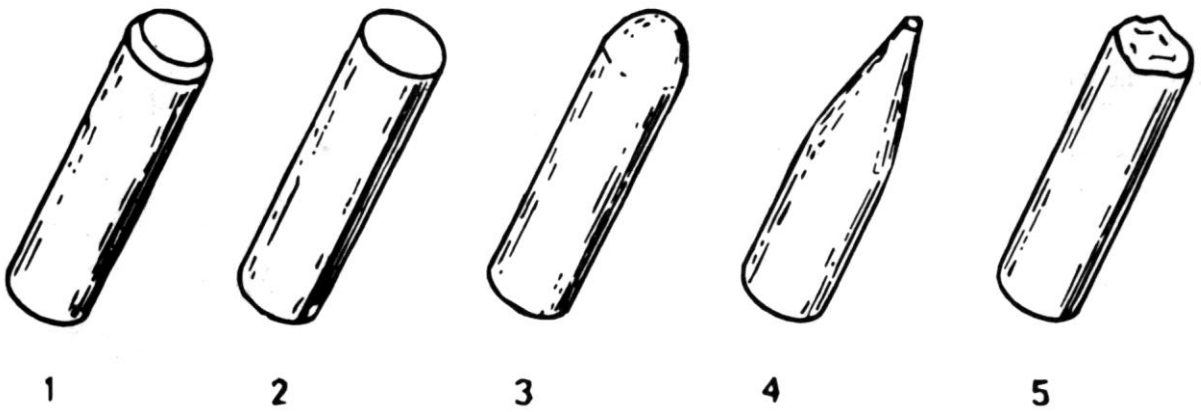


Figure 1-3: Examples of firing pins in different conditions. The nose on pin No. 1 is not rounded enough; No. 2 is too flat; No. 3 is perfect; No. 4 is too pointed; No. 5 is broken since the surface is jagged and uneven.

Such an inspection of a gun will usually reveal any defects. However, if no immediate cause is determined, the weapon should be disassembled, thoroughly cleaned, then reinspected. Before disassembling, you might want to run a few dummy cartridges through the magazine and action to check the feed mechanism.

When disassembling a firearm with which you are not familiar, study the mechanism very carefully and make notes of the location of the parts. In some cases, close-up photos (Figure 1-4) of the action from several angles may be called for if a complicated mechanism is encountered and no instructions or exploded views are available. Then upon reassembling the gun, the photos may be referred to if there are any questions about where a certain part goes. Another good idea is to organize the parts in the order they are removed. Then, in most cases, install them in the reverse order.

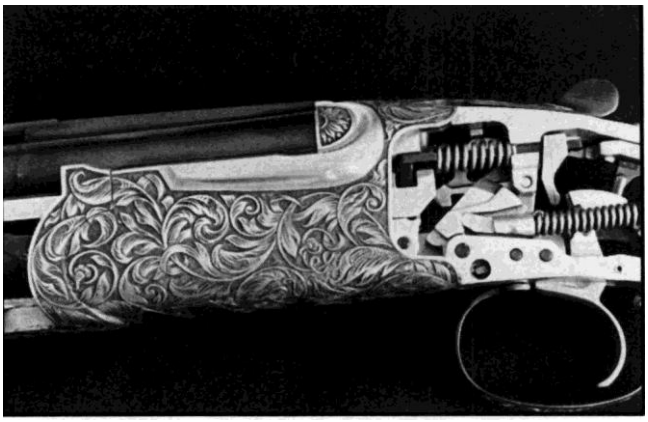


Figure 1-4: When there are no instructions or drawings of an unfamiliar firearm, close-up photos of the action, prior to disassembly, will help ensure that the action will be reassembled correctly.

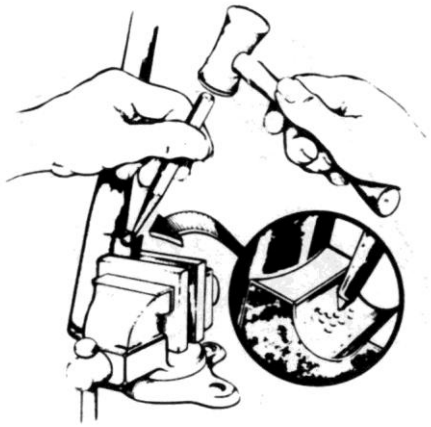


Figure 1-5: Excessive headspace in single-shot break-open shotguns can usually be temporarily repaired by peening the barrel lug.

If work is expected on a variety of firearms, invest in various reference books. First of all, get exploded drawings and disassembly/assembly instructions from all of the gun manufacturers. If you are a gunsmith or dealer with a Federal Firearms License (FFL), many of the manufacturers will send this information at no cost

You'll want to purchase a copy of the *Encyclopedia of Modern Firearms*, from Brownells Inc.; *NRA Guidebook to Shoulder Arms; NRA Guidebook to Handguns*; and the *Gun Digest Book of Firearms Assembly! Disassembly* series by J. B. Wood. You will use these books daily if much gun work is encountered.

Although troubleshooting charts and procedures help diagnose firearm malfunctions, they can never be complete. There are too many variations and solutions for a given problem.

To solve problems consistently, you must first understand the basic parts of all types of firearms, know how they function, and for what purpose. If you know that a particular part is not performing its job, then the cause of the malfunction is within this part or series of parts.

For example, upon inserting a shell in a single-barrel, break-open shotgun, cocking the hammer and squeezing the trigger, the hammer falls but the gun does not fire. What's the problem?

Wait a few seconds. Never open the locking mechanism of a firearm immediately upon misfire. The shell may explode seconds later after the locking mechanism is partially open, causing an injury. After waiting about ten seconds, open the breech of the shotgun and examine the chambered shell. Is the primer indented? If it is, then either the ammunition is defective or the firing pin/striking assembly is broken or weak.

If the ammunition is okay, the fault must lie with the gun. In other words, the firing pin is not striking the shell with sufficient force to ignite it. There could be several reasons for this:

- Broken or worn firing pin
- Weak hammer spring
- Excessive headspace between shell head and firing pin
- Debris in the firing-pin channel, preventing the pin from protruding far enough to ignite the primer

The experienced gunsmith can determine almost instantly which problem is causing the trouble. To illustrate, by the snapping sound when the hammer falls, he will generally know if it had sufficient force to enable a good firing pin to ignite the primer. By the same token, he will hear a cushioned sound if debris is preventing the firing pin from exerting its normal force. A quick glance at the breech mechanism will let him know if headspace is excessive.

On the other hand, a beginner will have to look for these problems systematically. Open the breech to expose the firing-pin hole. Now with the hammer down (not in the cocked position), pull the trigger back with your index finger and, at the same time, press in on the hammer with your thumb. The firing pin will be pushed forward as far as it will go. Examine the appearance of the firing pin as it protrudes through the firing-pin hole. It should extend about 1/16″ and its nose should be rounded. Should it protrude less or have a jagged nose, the trouble is due to a broken or worn firing pin.

Many inexpensive single-barrel shotguns have been damaged by firing short magnum loads over a long period of time. The lower locking lug or barrel lug becomes battered and leaves a certain amount of play between the barrel and the receiver. Use feeler gauges (the kind used to check spark plugs) to check the gap between the barrel and the receiver. A gap of ·020″ or more is dangerous and should be corrected or else the gun be scrapped. If the firing pin is not long enough to bridge the gap and strike the primer with sufficient force, the gun won't fire or the shell head could rupture, sending hot gases and small brass particles back at the shooter. To correct this, the gap must be closed by building up the barrel lug. However, a temporary repair can be made by peening the barrel lug to raise several small craters as shown in Fig. 1-5.

To check for debris in the firing-pin channel, remove the side-locking screw in the side of the receiver. The firing pin, along with its spring, should pull out easily while the hammer is cocked. Clean the firing pin and the channel. If the channel is rusted, use a good penetrating oil and small circular brush to remove the scale. This is also a good time to check the condition of the firing pin and its spring. If either shows signs of wear, replace them.

Another possible cause is a faulty mainspring. On most single-barrel shotguns, this lies in the receiver under the receiver tangs. To reach the mainspring, remove the buttplate. Then, with along screwdriver blade, remove the stock bolt and carefully slide the stock from the receiver tangs to avoid splitting it. Visually inspect the spring. Most are coil type and are very strong, but occasionally one breaks. A break should be obvious since the broken parts should be in the vicinity, held by the stock and the steel core that runs through the coil. If broken, replace the parts. If the spring has simply jumped out of position, reposition it and check for proper operation before reinstalling the stock.

This is just one example of thousands of problems that can cause malfunctions in firearms. Knowing how the various actions function will help you in troubleshooting any of these problems — and there are not that many different types.

Safety

There are certain safety rules which apply to everyone who handles firearms. The chief rule is never point a firearm at anyone or anything unless you intend to shoot it. This applies to both loaded and unloaded guns. Get in the habit of always checking the chamber and magazine of every gun you handle before doing anything else. Even after you have assured yourself that the gun is unloaded, always keep the muzzle pointed in a safe direction. If everyone would follow this rule, accidental wounds from firearms would be nil.

Make certain the firearm you intend to shoot is in good operating condition, with the proper ammunition being used, and that no obstructions — such as a cleaning brush or patch — are in the chamber or bore.

Beyond these, anyone who performs work on firearms should observe the following:

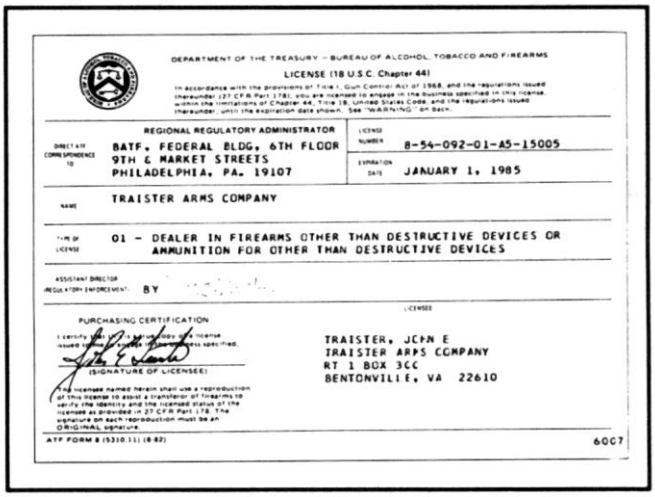
- Never apply heat to any part of a firearm unless you know exactly what you are doing; even then proceed with caution
- Never remove excessive amounts of metal from a rifle or shotgun action at points of stress; that is, receiver rings, locking lugs, and the like.
- When installing replacement parts, make certain that these parts are functioning properly before firing the gun.
- Be careful with trigger pull; avoid “hair” triggers.
- When inspecting a new gun, make certain it is unloaded; but always treat it as if it were loaded.
- Wear safety goggles when grinding, chipping, sanding or working with caustic solutions.
- Always make certain that you are competent and understand the principles of a gunsmithing job before attempting it

Your Federal Firearms License

Anyone who works on a firearm, other than his own, must obtain a Federal Firearms License (FFL). This includes even cleaning or oiling a gun. You will also need a license if you personally buy guns or ammunition for resale to others at wholesale or retail; reload ammunition for others, or buy, sell and benefit from substantial trade discounts from manufacturers and distributors of guns and related products. Even if you don’t plan to go into business immediately, it wouldn’t hurt to apply for your FFL now. It costs only $30 for three years and you will be entitled to substantial discounts from all distributors of gun and related items.

To qualify for an FFL, you:

- Must be 21 years of age or over.
- Must not (1) be under indictment for or have been convicted of a crime punishable by imprisonment for a term exceeding one year (not including business offenses, or misdemeanors not involving a firearm or explosive that are punishable by a term of imprisonment for two years or less); (2) be a fugitive from justice; (3) be an unlawful user or addicted to marijuana or any depressant, stimulant, or narcotic drug, or (4) have been adjudicated as a mental defective, or been committed to a mental institution.
- Must not, being a United States citizen, have renounced citizenship.
- Must not have willfully filed to disclose any material information, or made any false statement, as to any material fact in connection with an application for an FFL.
- Must have premises from which you conduct your business, or from which you intend to conduct a dealer’s business within a reasonable period of time.



DEPARTMENT OF THE TREASURY — BUREAU OF ALCOHOL, TOBACCO AND FIREARMS

LICENSE (18 U.S.C. Chapter 44)

In accordance with the provisions of Title I, Gun Control Act of 1968, and the regulations issued thereunder (27 CFR Part 178), you are licensed to engage in the business specified in this license within the limitations of Chapter 44, Title 18, United States Code, and the regulations issued thereunder, until the expiration date shown. See "WARNING" on back.

DIRECT ALL CORRESPONDENCE TO: REGIONAL REGULATORY ADMINISTRATOR
BATF, FEDERAL BLDG, 6TH FLOOR
9TH & MARKET STREETS
PHILADELPHIA, PA. 19107

LICENSE NUMBER: 8-54-092-01-A5-15005

EXPIRATION DATE: JANUARY 1, 1985

NAME: TRAISTER ARMS COMPANY

TYPE OF LICENSE: 01 - DEALER IN FIREARMS OTHER THAN DESTRUCTIVE DEVICES OR AMMUNITION FOR OTHER THAN DESTRUCTIVE DEVICES

ASSISTANT DIRECTOR (REGULATORY ENFORCEMENT): BY

PURCHASING CERTIFICATION

I certify that I am [illegible] of the license issued [illegible] business specified.

(SIGNATURE OF LICENSEE)

The licensee named herein shall use a reproduction of this license to assist a transferor of firearms to verify the identity and the licensed status of the licensee as provided in 27 CFR Part 178. The signature on each reproduction must be an ORIGINAL signature.

LICENSEE

TRAISTER, JOHN E
TRAISTER ARMS COMPANY
RT 1 BOX 3CC
BENTONVILLE, VA 22610

ATF FORM 8 (5310.11) (8-82)

6007

Figure 1-6: An FFL entitles you to buy and sell, at wholesale or retail, firearms and ammunition to residents of your state.

An FFL entitles you to buy and sell, at wholesale or retail, firearms and ammunition to residents of your state. You may also, depending on state laws, sell to residents of contiguous (adjoining), and other states.

You may operate out of your home, a garage, an outbuilding or a regular place of business; but you must be open to the public during the hours you specify on your application

Some local zoning laws may prohibit you from operating any business out of your home, or may prohibit the manufacture or storage of ammunition. So be sure you look into your local requirements for a business license to operate from your home, before making application for an FFL, if you intend to be open to the public.

When you specify "open to the public" on your application, you need only to open your doors for the time specified... or you can open "by appointment only." Many part-time gunsmiths have a regular job working for some other firm. Therefore, they prefer to open their own business a couple hours each day, say, from 6 P. M. to 8 P. M. weekdays, and from 9 A. M. to noon weekends. This is perfectly legal, as long as those hours are listed on your application, and then observed.

An FFL also entitles you to do gun repairs on the same premises, providing this phase of your business is also open to the public during the hours listed for nonrepair services.

To apply for your FFL, write to the Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms (BATF) at the same address you use when filing your federal income tax. Request an *Application for License Under U.S.C. Chapter 44, Firearms*. You will then receive an application, and instructions for filling it out. If you want only an FFL, enclose a check or a money order for $30. If you want both an FFL and an ammo maker's license, enclose $40.

In approximately six weeks to two months, you will receive your FFL if you qualify. It should be displayed prominently in your place of business. You will also receive a copy of the license; it is to be used when ordering firearms and ammunition. Have a few dozen copies made at your local office supply store or library.

When ordering firearms or ammunition for the first time from a manufacturer or supplier, send a signed copy with your order. When requesting catalogs, also send a copy of the license; most suppliers require a copy of an FFL as proof that you are entitled to trade discounts.

Your license is in effect until the expiration date shown on it. It covers operations only at the location shown on the license, and under certain restrictions, at gun shows and similar activities. When it is time for renewal of your FFL, the BATF will send a renewal application to you about 60 days before the expiration date shown on your license. If you do not receive your renewal application 30 days before the license expiration date, and you want to stay in business, immediately notify the BATF's regional office serving your state.

To renew your FFL, complete and send the application, with the fee attached, to your IRS center before the license expiration date. Then you may operate until you receive your new license, even though you may not receive it by the expiration date.

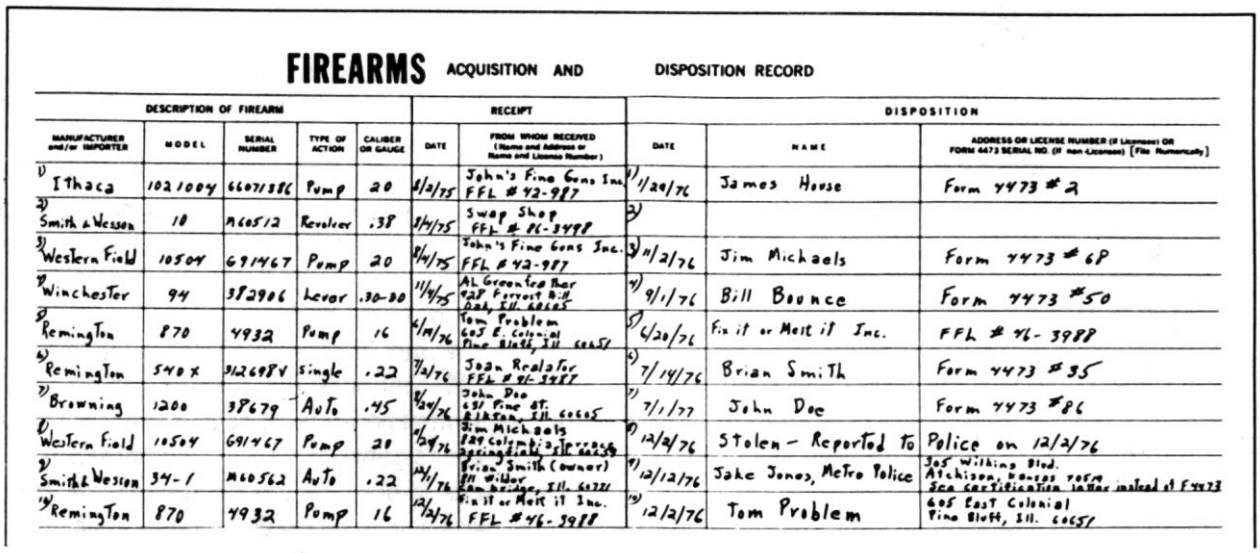
Keeping Records

Gunsmiths and dealers must maintain a separate permanent record of all firearms received and disposed of. This includes firearms received in pawn, curios and relics, and firearms received for repair.

Firearms must be logged in when received and logged out as they are disposed of, using a *Firearms Acquisition and Disposition Record*.

You will have to prepare Form 4473, the *Firearms Transaction Record*, covering the transfer of each firearm to a non-licensed person. Read this form carefully; it is the most important form or record you will keep. These forms must be kept alphabetically by name of purchaser, chronologically by date of disposition, or numerically by transaction serial number. The yellow Form 4473, Part 1, is used for over-the-counter sales; the green Form 4473, Part 2, is used for either contiguous (bordering) state sales or non-over-the-counter sales.

You must also keep a record of all ammunition received. Filing invoices in an orderly manner is acceptable, if they are kept separate from other commercial records. These records must be kept for two years.



FIREARMS ACQUISITION AND DISPOSITION RECORD

DESCRIPTION OF FIREARM					RECEIPT		DISPOSITION		
MANUFACTURER and/or IMPORTER	MODEL	SERIAL NUMBER	TYPE OF ACTION	CALIBER OR GAUGE	DATE	FROM WHOM RECEIVED (Name and Address or Name and License Number)	DATE	NAME	ADDRESS OR LICENSE NUMBER (If Licensee) OR FORM 4473 SERIAL NO. (If non-Licensee) (File Numerically)
1) Ithaca	102/1004	66071886	Pump	20	6/2/75	John's Fine Guns Inc. FFL # 42-987	11/20/76	James House	Form 4473 # 2
2) Smith & Wesson	10	M60512	Revolver	.38	8/4/75	Swap Shop FFL # 86-3498			
3) Western Field	10504	691467	Pump	20	8/4/75	John's Fine Guns Inc. FFL # 42-987	11/2/76	Jim Michaels	Form 4473 # 68
4) Winchester	94	382906	Lever	.30-30	11/4/75	AL Green Gun Shop 428 Forrest Blvd Dale, Ill. 60615	9/1/76	Bill Bounce	Form 4473 #50
5) Remington	870	4932	Pump	16	4/11/76	Tom Problem 605 E. Colonial Pine Bluff, Ill 60651	4/20/76	Fix it or Melt it Inc.	FFL # 76-3988
6) Remington	540 X	3126984	Single	.22	7/2/76	Jean Realator FFL # 76-3977	7/14/76	Brian Smith	Form 4473 # 35
7) Browning	1200	38679	Auto	.45	8/24/76	John Doe 631 Pine St. Elkton, Ill. 60605	7/1/77	John Doe	Form 4473 #86
8) Western Field	10504	691467	Pump	20	9/24/76	Jim Michaels 824 Columbia Terrace Springfield, Ill. 60634	12/2/76	Stolen - Reported to	Police on 12/2/76
9) Smith & Wesson	34-1	M60562	Auto	.22	10/1/76	Brian Smith (owner) 811 Willow Elm Bridge, Ill. 60721	12/12/76	Jake Jones, Metro Police	305 Wilkins Blvd. Atchison, Kansas 66078 See certification letter instead of F4473
10) Remington	870	4932	Pump	16	12/2/76	Fix it or Melt it Inc. FFL # 76-3988	12/2/76	Tom Problem	605 East Colonial Pine Bluff, Ill. 60651

Figure 1-7: Your Firearms Acquisition and Disposition Record must be kept current.

You do not have to keep a record of the disposition of ammunition for shotguns and ammunition used only in rifles, or component parts of these types of ammunition But you must keep a separate, permanent record of the disposition of handgun ammunition, or ammunition that is interchangeable between handguns and rifles — such as ·22-caliber cartridges.

Transfer Between Licensees

Licensees may freely buy and sell firearms and ammunition among themselves. They do not have to prepare Form 4473 on transfers to other licensees; these transactions must be recorded in a bound record book. The licensee receiving the firearms or ammunition must furnish a copy of his or her license to the licensee selling, or otherwise disposing of, any firearm or ammunition, prior to making the transaction. Licensees may also ship interstate to other licensees.

Dealers may take orders for firearms and ammunition at any location, but the orders must be filled only at your licensed premises or other approved location.

Know Your Customer

Identify the buyer by name, age, and residence address before delivering any firearm or ammunition Under federal law, the minimum age for purchasers of firearms and ammunition may be either 18 or 21 years, depending on the item being purchased. You may not sell a handgun or handgun ammunition to persons under 21 years of age. You may not sell shotguns or rifles, or shotgun and rifle ammunition, to persons under 18 years of age. You may sell ammunition that is interchangeable between rifles and handguns to a purchaser who is at least 18 years of age, if you are satisfied that he or she will use the ammunition in a rifle.

If you sell or deliver a handgun to a non-licensed person, that person must be a resident of the state in which your licensed premises is located. If you sell or deliver a rifle or shotgun to a non-licensed person, that person must be a resident of the state in which your business is located. In some cases, you may sell firearms, other than handguns, to a resident of another state. This latter condition is valid only if the buyer's state has enacted legislation allowing such a sale or delivery. The sale conforms to legal requirements in both states when the appropriate law enforcement officer in the buyer's home state has been notified, as required, and the waiting period observed.

In addition to these requirements, you may not lawfully sell or dispose of any firearm or ammunition to certain types of persons, such as convicted felons. If any of your customers violate any state law or local ordinance that applies at the place where you sell or deliver, by purchasing or possessing any firearm or ammunition, then, under federal law, you may not lawfully sell or deliver any firearms or ammunition to that customer.

If firearms are lost or stolen, you should immediately contact your local law enforcement authorities. If you deliver more than one handgun to the same individual non-licensee within five consecutive business days, this must be reported to the BATF on Form 3310.4. The original copy of this form must be mailed to the BATF's Criminal Enforcement Office for your area at the end of the business day of which the sale occurs. A list of these offices will be included with a supplemental booklet when you receive your FFL.

Licensed collectors may buy curios and relics from any source, and they may be disposed of to another licensee anywhere, or to non-licensed residents in the collector's state. A collector must maintain the same records as other licensees. A collector's license entitles him or her to conduct transactions in curios and relics *only*.

If a licensee moves his business location, the regional regulatory administrator must be notified at least 10days before moving the firearms and ammunition to a new address.

If you go out of business, the following must be observed: Within 30 days after the licensee sells or otherwise discontinues the firearms or ammunition business, written notice must be given of this change in status to the regional regulatory administrator. If the licensee sells or discontinues the firearms or ammunition business and is succeeded by a new licensee, the firearms dealer records should be marked to show this fact, and must be delivered to the successor.

You must deliver all of your forms to your BATF regional regulatory administrator within 30 days of going completely out of the firearms or ammunition business. Also be aware that these regulations change from time-to-time; keep abreast of what's happening.

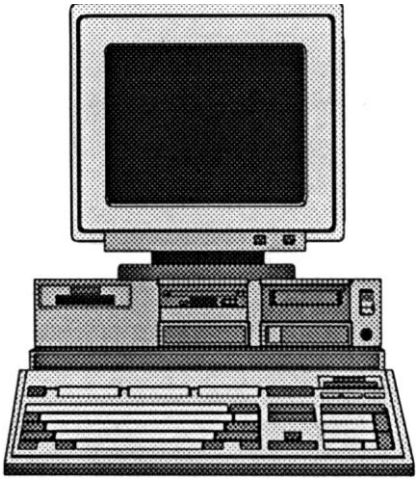


Figure 1-8: The use of a computer, and one of the several programs designed especially for firearms dealers, makes record-keeping much simpler.

Chapter 2 - Tools Of The Trade

In order to disassemble, repair, and reassemble firearms, gunsmiths use certain types of equipment, tools, and materials. Understanding these tools is important prior to working on any firearm to speed up the process and to prevent any damage to the gun or its finish. Every gunsmith should have these minimum essential tools to do good work on the usual kind of firearm repairs:

- Solid workbench
- Large machinist's vise with 3½″ jaws
- Ballpeen hammer
- Plastic mallet
- Brass mallet
- Numbered drill set, 1-60
- Small ¼″ electric hand drill with accessories
- Set of gunsmith's screwdrivers
- Long-blade stock bolt screwdriver
- Flat bastard file, 12-inch
- Half-round bastard file, 12-inch
- Round bastard file, 10-inch
- Half-round wood rasp, 12-inch
- Mill file, 10-inch
- Set of 6-inch needle files
- Needle-nose pliers
- Combination pliers
- Set drift punches
- Center punch
- Small set of woodworking tools
- Propane torch
- Micrometer, 1 -inch, and/or calipers
- Bench knife
- Allen wrench set
- Set of jeweler's screwdrivers
- Cleaning brush
- Arkansas stone file set

This list is by no means complete, but these items are the "rock" on which to build or expand your professional assortment of fine tools. Your first project, for example, may require damaged checkering to be recut. Then you'll have to add a set of checkering tools to the list. Perhaps you have a lot of Winchester Model 12 shotguns to disassemble; you'll want Brownells' Winchester Model 12 wrench, and so on.

Workbench

In a pinch, almost any flat surface can be used as a workbench to repair firearms, but nothing is quite as discouraging as having the surface move or wobble when you're trying to perform some delicate operation. Therefore, try to build a solid bench of heavy lumber. The one in Fig. 2-1 is a good starter bench that can easily be constructed in a day's time. The frame is made from 2-by-4 members, reinforced with ⅜″ plywood. The shelf is made of ¾″ plywood glued together. A piece of hardboard nailed with finishing nails to the top protects the bench top and can be changed often and inexpensively.

A somewhat heavier bench may be constructed by using 2-by-6 boards in place of the two layers of plywood. For extra sturdiness, secure the legs to the floor with angle irons (Fig. 2-2).

I use a U-shaped bench. By using 2-by-4 framing, 4-by-4 posts, two layers of ¾″ plywood for the top, and securing the back of the bench framing to the building studs, I obtained an unusually firm working surface with minimal effort and expense.

You should design your bench to fit into the available space and serve your own needs. If you're handy with woodworking tools, you'll want to build a few drawers for certain tools, or you can buy the prefabricated types of steel or plastic and install them by screwing the brackets to the underside of your bench.

You may be able to tune-up an existing workbench in your home. A shaky bench can be braced and reinforced with bolted crosspiece supports, securing the legs to the floor as mentioned previously. If the work surface presently has cracks between the boards, cover the entire surface with a piece of plywood or hardboard to prevent losing small gun parts, screws, etc. Edges may be faced with wooden strips for a neat appearance.

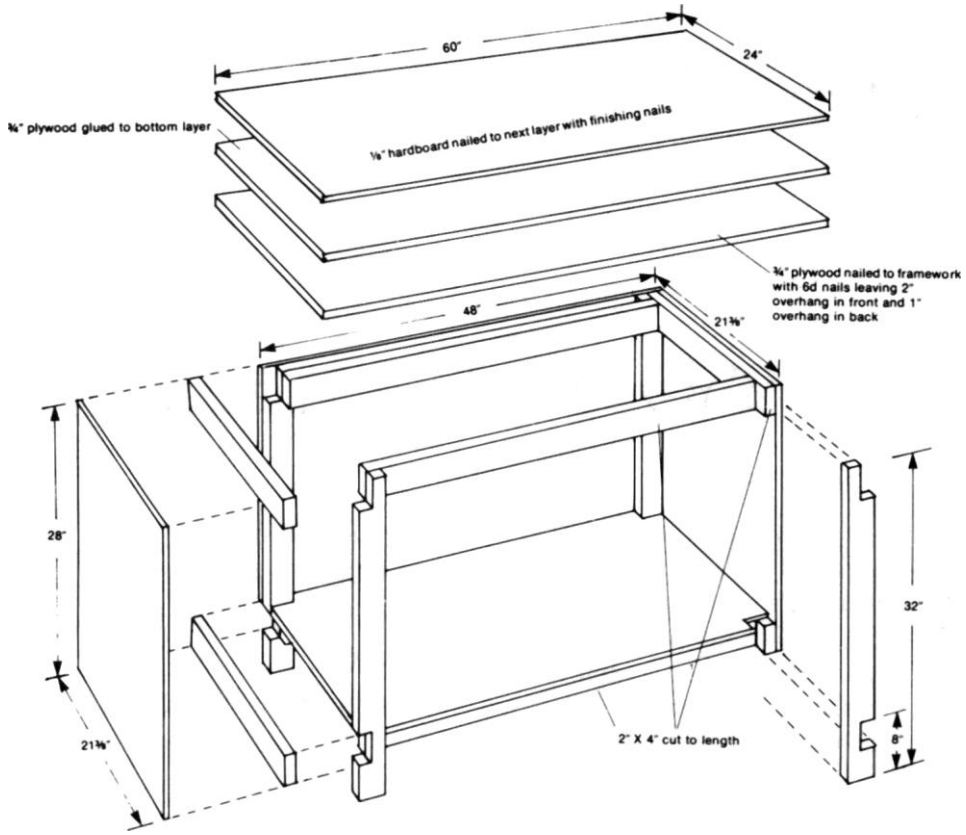


Figure 2-1. A good basic bench for the beginning gunsmith. As the business expands, and the need for a larger main bench increases, this smaller bench may still be used as an auxiliary bench.

Even with the best work surface, you'll need good lighting to do your best work. I use a flexible-arm incandescent lamp mounted on the bench and ceiling-mounted fluorescent lighting fixtures. Although my shop has excellent general illumination, I found myself moving precision work (checkering, gold inlaying, etc.), trying to find a spot that wouldn't throw shadows on the work. This flexible-arm lamp can be positioned anywhere along the bench where light can be flooded to the exact spot needed. The spring tension holds the arm exactly where I swing it, and even the lamp head can be rotated.

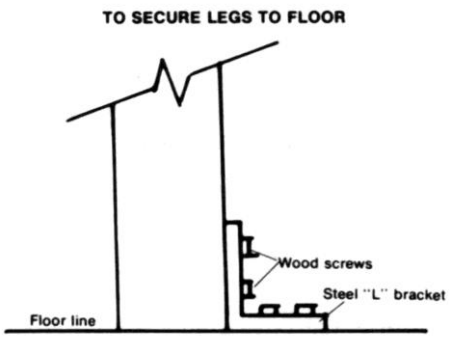


Figure 2-2: Workbenches may be made sturdier by securing the legs to the floor with angle irons.

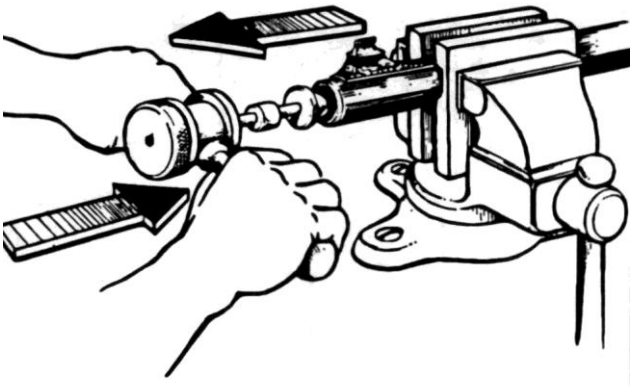


Figure 2-3: A heavy bench vise is necessary on every workbench.

Bench Vise

The bench vise in Fig. 2-3 has 3½″ jaws and finds many uses around the shop. It has a swivel base, is relatively rugged, has serrated-steel replaceable top jaws, steel replaceable pipe jaws, and a large anvil. It performs functions from bore sighting rifles (using leather jaw pads), to holding parts while filing, to holding a checkering cradle. I also use removable brass and wooden jaws to prevent marring blued metal surfaces when a gun is supported for repair work or disassembling.

A smaller vise is also useful for work on small parts. The Versa-Vise is one of the most useful small vises a gunsmith can have. It turns a full 360° in either the upright or laid-flat position. The vise automatically locks in the desired position when the jaws are clamped tight. Serrated pipe jaws for round objects to 1½″ in diameter are provided as well as a built-in anvil.

Ballpeen Hammer

Ballpeen hammers for gun work should be of two sizes — one with a four-ounce head and the other with an eight-ounce head. The smaller weight is normally used for upsetting or swaging to hold pins or parts in place. For example, have you ever run across a loose dovetail sight base? It can be tightened by slightly peening the shoulders of the slot until they are snug against the sight base. The larger weight is designed for the heavier duty jobs around the shop (Fig. 2-4).

Plastic Mallet

A plastic mallet is valuable around any shop for driving pins, installing or removing sights, seating inlays, and many other jobs that require pounding without marring the metal or wood

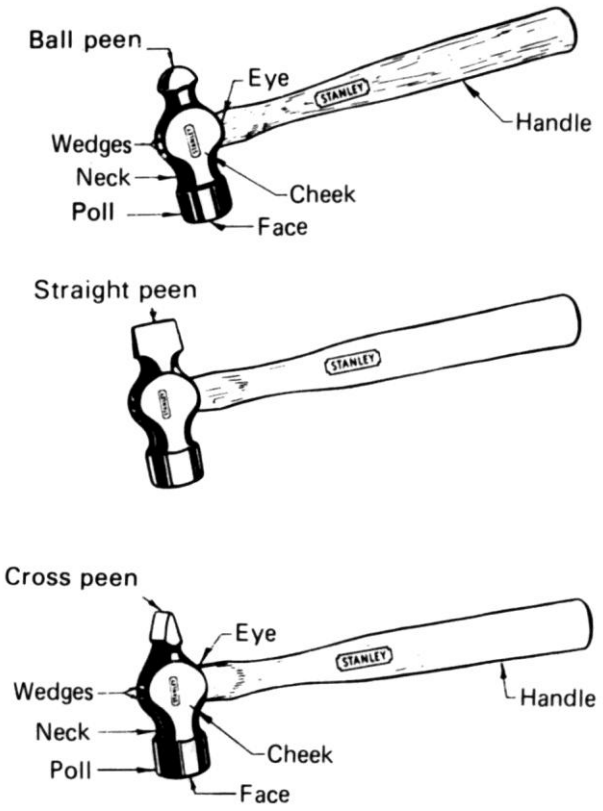


Figure 2-4: Description of the different types of peening hammers frequently used by gunsmiths.

Brass Mallet

A brass mallet is also used when you don't want to mar the finish. However, the additional weight of the brass mallet gives a little more "whack" when you need it.

Drills

A set of cheap drills may be purchased from the mail-order houses for less than $10, but don't buy them for gun work. At first you can probably get by with a No. 28 and No. 31 bit for most of your sight-mounting work. Eventually you'll want a complete set of numbered drills from 1 to 60, a fractional drill set from 1/16″ to ½″, and a letter drill set from A to Z.

Eliminating breakage depends on the correct point grinding of the drills when they need to be resharpened and sharpening them when they become dull. It has been estimated that 90% of all drill breakage is caused by incorrect grinding.

A drill grinding attachment permits the user to repoint drills to factory accuracy easily and quickly on a bench grinder. It will point all of the fractional and letter sizes mentioned previously and number sizes to No. 30.

When pointing drills, the following must be carefully considered:

- Lip clearance. The attachment just mentioned is adjustable from 8 to 14 degrees.
- Point angle. The high positive angle adjustments on the drill grinding attachment are 88, 68, 59 and 49 degrees.
- Cutting edges.
- Point thinning.

The cutting edges of a drill must make exactly the same angle with the centerline of the drill. If the cutting edges arc of unequal length, the point or chisel point is off-center, even though the point angle may be uniform on both edges. This condition will cause the drill to cut oversize.

The web of a drill increases in thickness toward the shank and a web-thinning operation becomes necessary when the drill has been shortened by repeated grindings. This operation is essential in order to minimize the pressure required to make the drill penetrate. The point-thinning operation must be carried out equally on both sides of the web, otherwise the web will be off-center and the drill will produce an oversize hole. As a general rule, a web thickness of approximately 12½% (⅛) of the drill diameter is recommended at the point.

Electric Hand Drill

If you would walk into any professional gun shop in the country, you would probably see the small Moto-tools being used more than any other hand tool. I have two variable-speed Moto-tools that are kept constantly busy. However, if you would take all of the other power tools out of the shop — drill presses, bench grinders, polishers — and then ask what one power tool most pros would keep, chances are they would tell you that the ¼″ electric hand drill is the one to keep — provided they get to choose the many available accessories. You'd be surprised at the number of gunsmithing operations a little electric drill can perform.

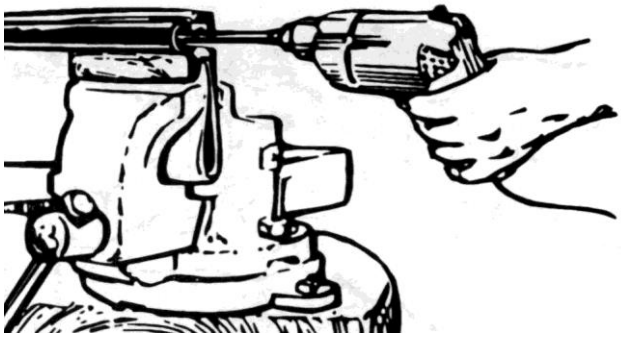


Figure 2-5: A portable electric hand drill will find many uses around the gunshop.

Yes, the portable electric hand drill should be the beginner's first power tool, mainly because of its low cost and the number of jobs it can perform in the gunshop. Here are a few:

- With the many jigs available, you can accurately drill all holes for mounting telescope sights and sling swivel studs.
- A drill press attachment is available for around $25 that will let you do bolt jewelling and many other precision drilling jobs.
- Cloth polishing wheels may be attached to the chuck and, with the use of polishing compounds, you can polish a gun ready for bluing.
- When circular wire brushes are attached to the chuck, rust may be effectively removed from metal surfaces as well as polishing them. These brushes may also be used for carding metal surfaces during the hot-water bluing process.
- A sanding disc attached to the drill motor lets you smooth down a recoil pad that you are fitting to a gun stock. This same pad may be used for rough-sanding a gun stock prior to refinishing.
- Circular cutters and brass balls may be chucked in the drill for crowning the muzzle of gun barrels.
- A polishing pad may be used in the drill for polishing a gun stock when wax is applied.
- The drill may be used as a lathe by securing the drill to a bench stand or vise and the metal object secured in the drill's chuck. For example, an oversized screwhead may be turned to size. The screw is rotated in the drill while a file cuts a perfectly round surface.
- When a grinding head is attached to the drill, it becomes an effective bench grinder for sharpening drill bits.
- A flexible shaft may be attached to the chuck to operate in tight places similar to the Moto-tool.

This is just a sampling of what the little ¼″ electric drill can do. A little imagination will certainly enable you to think of several other uses. Look through some of the tool catalogs for other attachments available for the electric hand drill. Then decide which ones you need for your particular work.

Screwdrivers

Most inspections and repairs on firearms will require screwdrivers, and your set should include one designed especially for gun work. The efficient holding power of a screwdriver depends upon the design of the blade and the external force that may be applied. The blade should fit down into the screwhead slot so that the torque is applied evenly and also should be fitted to the width of the slot for best results.

I personally like the set of gunsmith's screwdrivers manufactured by the Chapman Manufacturing Company. It contains an extension, a midget ratchet, one screwdriver handle, twelve slotted-head adapters, two Phillips-head adapters, and one Allen hex-type adapter. You'll also find use for Allen head adapter which includes one ¼″ square drive adapter.

If you just buy the conventional Allen wrenches, make sure you get a metric set also. I still get red-faced when I think of the time a customer came into the shop with a simple job of removing a telescope sight. I tried every Allen wrench in the shop, but none would fit. When I told the customer that I'd have to grind one of my conventional wrenches down to fit, he left in disgust. Imagine taking over thirty minutes to find an Allen wrench to fit and then failing to find one. It dawned on me about ten minutes after the customer left that the Allen screws were metric since the mounts were made in Japan. Needless to say, I immediately purchased a set of metric Allen wrenches.

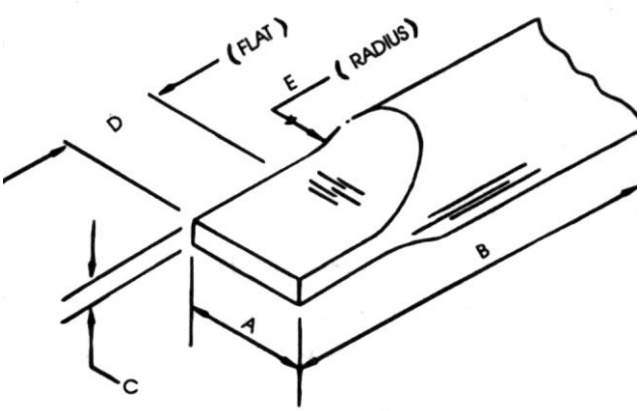


Figure 2-6: How gunsmithing screwdrivers are measured: (A) blade width, (B) shank length, (C) blade thickness, (D) blade length, (E) radius of the curve from the flat portion of the blade to the outside of the shank. To fit a gun screw properly, all of these dimensions must match the screwhead in question.

Long-Blade Stock Bolt Screwdriver

You'll need a stock bolt screwdriver with a ½″ blade, 15″ long for removing most stock bolts. Once you get into the gun-repair business, you'll want to purchase a set of stock take-down tools. The buttstock of many two-piece stocks are securely tightened with several different types of bolts: hex-head, screw-slot, and combinations. All are tough to remove and often require special tool set-ups to fit these various screwheads and to handle the force required to remove them correctly and to retighten solidly.

Flat Bastard File

The flat bastard file is used primarily to remove surplus material. Assume that you've just scribed the outline of a broken gun part on a piece of steel stock — a hammer for an old single-barrel shotgun is a good example. You then use your drill press to drill holes around the outline. Now you secure the part in a vise and start filing away at the excess metal until it more closely resembles the part you are trying to make. In doing so, try to regulate the file's motion so that the file marks cross and recross each other. This helps keep the metal surface true and also cuts more efficiently.

Half-Round Bastard File

The half-round bastard file is also used for removing surplus material, but on a curved surface.

Round Bastard File

The round files are used for fast removal of metal or as rasps to slightly enlarge or adjust accessory holes in wood stocks. They are also used for adjusting screw holes and pin holes, scope mount holes, other tightly curved parts, and all types of parallel round cuts.

Mill File

Mill files are parallel in thickness from the heel to the point and are usually tapered so that the width at the end equals about ¾ the width of the stock. They are also made of equal width and thickness throughout their length. The teeth are ordinarily single-cut bastard. Other cuts include No. 2 and smooth. This file is used in the gun shop for lathe work, draw filing, and for filing brass and bronze.

Set Of Needle Files

A set of needle files is especially useful to the average gunsmith. Most sets consist of 12 assorted files in four types: equaling, square, three square, and half-round. Cuts are medium and fine.

Needle-Nose Pliers

Perhaps no other tool on the workbench is required to do more work than the needle-nose pliers. They are usually used to grasp small objects in hard-to-reach places inside of actions. The tips of the pliers are easily bent if they are misused and should therefore never be used for loosening or tightening a screw or nut (Fig. 2-7).

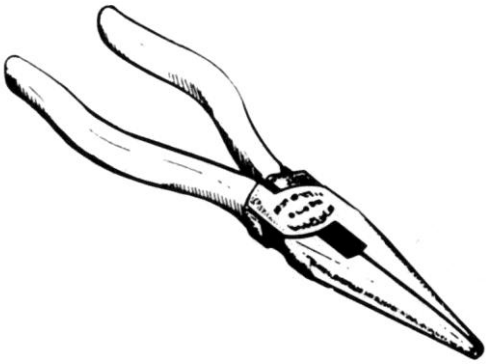


Figure 2-7: Needle-nose pliers will be used for many gunsmithing applications, from holding small parts to holding cotton swabs for bluing and browning.



Figure 2-8: Combination pliers are probably the most common type found around any shop.

Combination Pliers

Combination pliers (Fig. 2-8) have been used in the shop and household for everything from driving tacks to pulling teeth. They also have a place in the gun shop. In general, a slip joint holds the two parts of the pliers together so that the jaw can be opened or closed to hold large or small objects. Most adjustable combination pliers have two cutting edges at the back of the jaws for wire cutting. However, the main purpose of the pliers is for gripping. I use mine for holding small parts to be blued by the torch-and-oil-dip method, inserting springs, or gripping almost everything.

Set Of Drift Punches

A set of punches is required for removing the assembly pins used in most firearms (Fig. 2-9).

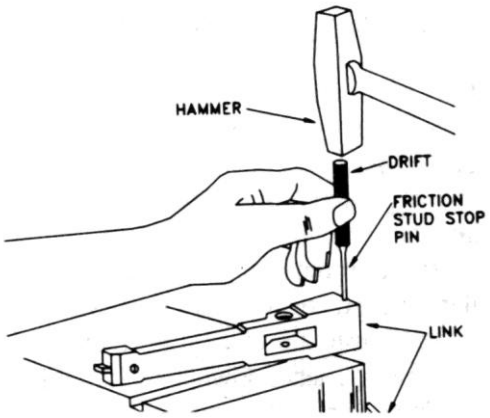


Figure 2-9: Drift punches are necessary for disassembling practically every type of firearm in existence.

Woodworking Tools

If you picked up a catalog and looked through the pages at the various tools for woodworking, you'd be amazed at the large array available. If you purchased all of them, you'd probably be just as bewildered as to how and when to use them. To simplify matters, all you'll need at the very beginning are the following:

- Smooth cut cabinet rasp for smoothing and shaping the stock.
- Chisel and gouges to cut away the extra wood required in working with a semi-inletted gun stock.
- Bottoming file for flat bedding of the action.
- Barrel inletting rasp to shape the barrel channel to the exact dimensions of the barrel.

Propane Torch

Any of the propane torch kits on the market will suffice for a start. These will handle lead-tin soldering and some silver soldering jobs on steel but will not handle brazing or welding.

Micrometer

This is one instrument that you won't use as frequently as others; but when you need it, you need it Working with gun repairs, you will occasionally be required to obtain many types of measurements. For precision measuring on gun parts, barrel slugs, etc., the micrometer (0 to 1″) is the tool to use.

The main parts of the micrometer are the frame, anvil, spindle, barrel, and thimble. All of these are shown in their proper perspective in (Fig. 2-10). The movement of the rotating thimble will adjust the spindle toward or away from the anvil; that is, turning the thimble clockwise moves the spindle toward the anvil, and turning the thimble counterclockwise moves the spindle away from the anvil.

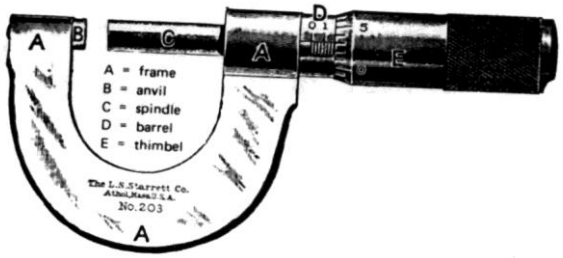


Figure 2-10: Typical micrometer.

Vernier Caliper

Basically, the vernier caliper is made of two graduated steel rules, such as shown in Fig. 2-11. One rule is fixed and is called the fixed rule or frame. The fixed rule is attached to one end of the frame. The second rule is movable and slides along the frame. One end of the sliding rule has the other measuring jaw attached. This jaw is called the adjustable, or sliding jaw.

To measure an outside diameter with a vernier caliper, place the object snugly between the jaws of the caliper as shown in Fig. 2-12. Figure 2-13 shows a vernier caliper measuring the inside of a shotgun barrel.

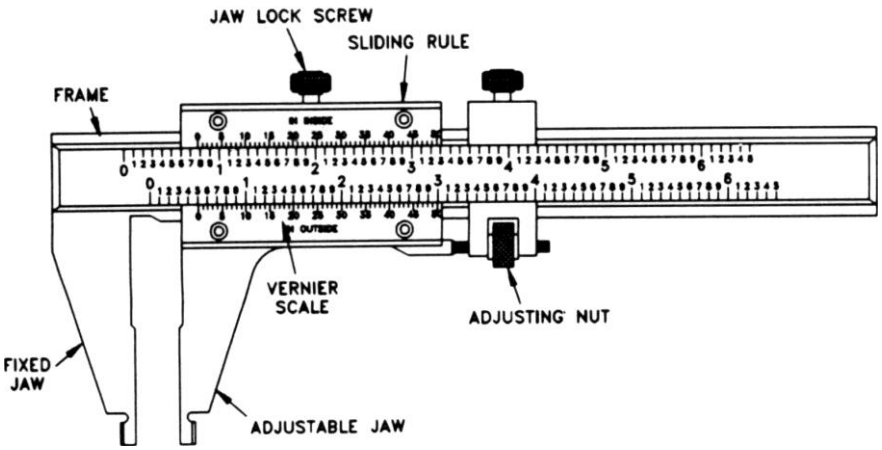


Figure 2-11: A vernier caliper.

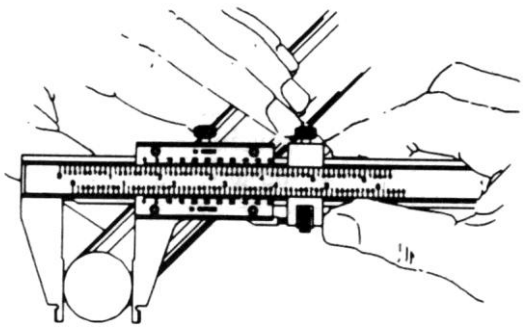


Figure 2-12: Using the vernier caliper to measure the outside diameter of a shotgun barrel.

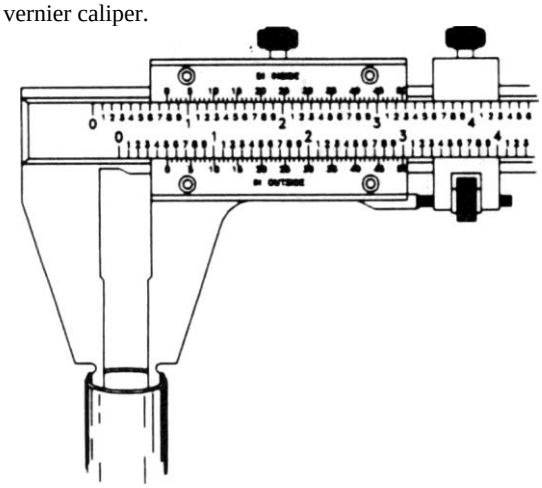


Figure 2-13: Using a vernier caliper to measure the inside (bore) diameter of a shotgun barrel.

Bench Knife

You will find many uses for a bench knife, if only to cut the plastic cap from a can of gun oil (Fig. 2-14). Its practical applications include cutting guidelines for checkering patterns and puncturing slots for screws in rubber buttplates.



Figure 2-14: Brownells' bench knife.

Jeweler's Screwdrivers

The gun repairman will occasionally run across a screw slot that even your set of Chapman Gunsmith's screwdrivers won't touch. Here is where a set of jeweler's screwdrivers comes in handy. The most frequently encountered applications for these screwdrivers will include sight adjustment screws, small screws on some handguns, etc.

Cleaning Brushes

For getting into those tight, hard-to-get locations, a common toothbrush will do wonders. However, there are gun-cleaning brushes that get at those tight places to remove greasy gun dirt, yet won't scratch the bluing or other finish.

Arkansas Stone File Set

Indian and Arkansas stones are needed in the gun shop for precision trigger and sear work, accurizing, and close fitting. Arkansas stones are also used extensively for sharpening gunsmithing tools such as knives, chisels, and gravers. Each grade of Arkansas stone has a special sharpening application, and the user should obtain catalogs to see what the manufacturer's recommendations are.

Chapter 3 - Single-Shot Rimfire Rifles

There is really very little that can go wrong with most ·22 caliber single-shot bolt-action rifles, but these little things are still subject to certain common malfunctions. The most prevalent of these problems are failure to fire, failure to extract, failure to eject and inoperative safeties. On rare occasions, the gun may fire upon closing the bolt. Of course, these guns are also subject to leading—the same as any other weapon that fires lead bullets—and most inexpensive, 22s have creepy, heavy triggers that could use a little work.

Due to the simplicity of most ·22-caliber singleshot rifles, this gun is good for the beginner to start learning about troubleshooting techniques and firearm repairs. You can get a quick overview of the common problems and how to repair them. Furthermore, these techniques can be used on the more complicated designs that will be encountered in the future.

Failure To Fire

The chief cause of misfires in ·22-caliber guns is a broken or damaged firing pin. This problem is often caused by repeatedly snapping the gun on an empty chamber, a practice that should obviously be avoided. If the striker or firing pin must be lowered when the chamber is empty, hold the trigger back while closing the bolt and turning down the handle. This will ease the striker down gently.

When a gun won't fire, examine the cartridge that was chambered when the trigger was pulled. If the fired cartridge shows no mark on the rim, then the cause is most likely a broken firing pin — especially if you hear a distinct "snap" of the striker when the trigger is pulled. On the other hand, if the cartridge has a slight indentation or you don't hear a definite "snap" when the trigger is pulled, chances are the problem is caused by a broken or weak firing-pin spring. Experience will enable you to detect these problems instantly.

In either case, the bolt should be disassembled and the mechanism inspected. This procedure involves unscrewing the safety screw (cocking knob) and knocking out various straight pins which hold the extractor, cartridge guide, firing pin, etc., in place. An exploded drawing of the bolt will be a big help when you go to reassemble the bolt (Fig. 3-1). If an exploded drawing is not available and you're new at the game, make notes and simple drawings while you're taking the bolt apart. This will keep you on the right track when you're putting the parts back in place.

Be careful not to lose the parts. Keep all small parts to each section of a firearm in separate plastic drawers or self-sealing plastic bags. If it's going to be awhile before the parts are reassembled, mark each drawer with appropriate notes for identification.

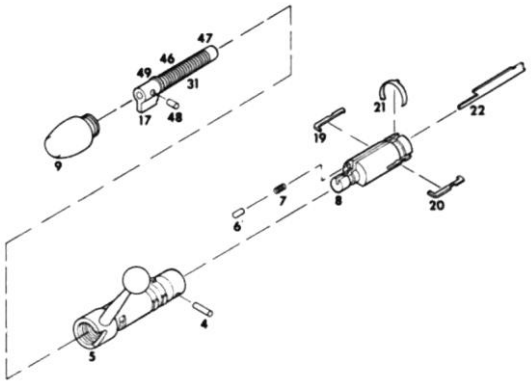


Figure 3-1: Exploded drawing of a bolt for a Remington Model 540-XR bolt-action rifle.

Once the bolt is disassembled and you find that the firing pin is broken, a factory replacement is always best. However, if the gun is obsolete and parts are not readily available, you may have to repair the old one. A new pin can be made from flat stock and welded on, but it must be heat-treated or it will wear and break quickly.

If you have the time, entire firing pins can be made in the shop from drill rod and/or flat stock. This can be done with a small lathe, but a firing pin can be turned by clamping the stock in a small ¼″ drill (held in a vise) and letting the metal stock rotate against a flat file. Use the old pin as a guide and check the dimensions frequently. A firing pin that is too long may fire the gun upon closing the bolt, and one that is too short will result in misfires.

If the firing pin is not broken, the second most common cause of misfires is a weak or broken firing-pin spring. Sometimes part of a spring may have been broken and the owner may have stretched it enough to make it function. However, this stretched tension won't last. The only sure solution is to replace the spring. When you get a new spring from the factory, it's going to be longer than the replaced one because it takes a while to set. Before long, though, the new spring will feel like the old one except that it will work.

If neither the firing pin nor the firing-pin spring is damaged or weak, the most logical remaining cause is debris inside of the bolt. Of course, in sub-freezing temperatures a small amount of grease inside the bolt can congeal and gum up the entire works. Only a light coat of thin gun oil should be used in moderately cold climes, and in sub-zero temperatures the gun should be. completely free of any oil or grease; remove it with AWA 1,1,1, or a similar degreaser.

To clean grease and debris from the bolt assembly under normal conditions, obtain a container large enough to hold the parts and a good cleaning/degreaser solution. The ratio should be about four parts water to one part cleaning solution The dirtiest parts, if left to soak in this solution for fifteen or twenty minutes, will come out clean and ready to dry, oil, and assemble. You can help the process by scrubbing the parts with a toothbrush after they have soaked for about ten minutes.

Remember that a thorough cleaning of a firearm will often correct many malfunctions without any further work. Grease and the assorted debris it attracts can gum up any action to the point that it functions poorly. This is especially true of semiautomatic guns. Make it a habit to clean every firearm thoroughly before troubleshooting malfunctions or making repairs. Even if the trouble is due to worn, broken, or damaged parts, their cleanliness will help you spot the trouble more quickly.

Failure To Extract

An extractor withdraws fired cases from the chamber and, in the case of magazine rifles, guides each live round of ammunition into the chamber as it is stripped from the magazine. Worn, broken, and missing extractors are common problems with ·22-caliber single-shot bolt-action rifles. When one of these problems is encountered, however, installing a new extractor may not always solve the problem — for long. For example, ·22 rifle chambers may become extensively corroded by frequently firing ·22 shorts in a gun chambered for the ·22 Long Rifle cartridge (see Fig. 3-2). Then when ·22 Long Rifle cartridges are fired, the longer cases swell into the eroded area, making extraction difficult. Extractors are under a great deal of strain in normal circumstances. When this additional strain is encountered, the extractor wears quickly, slipping over the case rim when the bolt is withdrawn. A new extractor will help for a while, but the problem will reoccur in due time.

The worn extractor can be due to a dirty bore, and a thorough cleaning and new extractor will normally solve the problem. If the extractor isn't worn too badly, the angle of the hook can sometimes be corrected by light honing.

When extraction is a problem, first check the chamber of the weapon (after cleaning) and look for tool marks and pits. If either are present, smooth up the chamber as best as possible using a very fine emery cloth and then polish with crocus cloth. A hardwood dowel turned to the approximate shape of the chamber, and of a diameter so that one thickness of abrasive paper wrapped around the rod will fit snugly into the chamber, should be used for the polishing. Just be sure not to enlarge the chamber so much that it will be oversized for the cartridges.

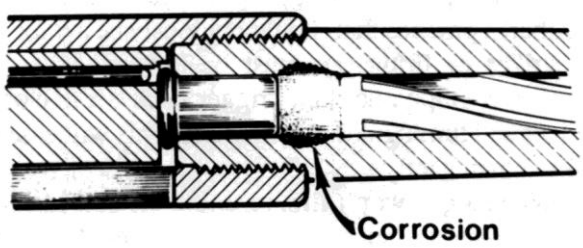


Figure 3-2: Twenty-two caliber rifle chambers may become extensively corroded by the frequent firing of ·22 Shorts in a rifle chambered for the ·22 Long Rifle.

Now try some new cases for extraction. If the problem has not been corrected with the polishing, a new extractor will have to be installed or the old one honed to the proper angle to make it serviceable. Also check the extractor spring; this obviously can cause problems, too. Replace the spring if worn or broken.

Failure To Eject

The ejector flips the cartridge from the extractor's grip at the proper instant Therefore, both the extractor and the ejector work as a team, and a problem with one could cause a problem with the other. For example, the extractor could be worn or damaged, preventing the ejector from working. A loose extractor can prevent the ejector from throwing the spent cartridge away from the gun.

When an ejection problem is encountered, first check for dirt and foreign matter which could be blocking it and preventing it from functioning property. A broken or worn ejector should be easily recognized and must be replaced. If you can't find anything wrong with either the extractor or the ejector but the gun still doesn't eject properly, check the pin holding the ejector in the bolt. It may be bent or burred, thus preventing the ejector from moving freely.

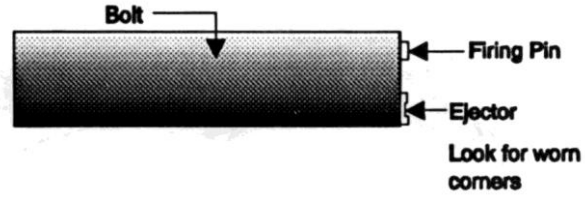


Figure 3-3: A close examination of the ejector should easily reveal if it is worn or not.

Inoperative Safeties

Safeties on ·22-caliber single-shot bolt-action rifles vary considerably. The Winchester Model 69, for example, uses the cocking piece as a safety. In other words, the bolt does not cock on opening or closing. It is manually cocked by pulling back on the cocking piece until the trigger sear engages and holds the striker in a cocked position. The striker is released when the trigger is pulled. Other rifles must be cocked in a similar manner, but also have a rotary safety screw. Some cock upon closing the bolt and have either a safety screw on the bolt or a button safety along the side of the action.

The Mossberg Model 320K has a safety that goes on automatically when the action is opened and won't fire until the action is locked and the safety is in the *OFF* position. Some of the early ·22s utilized a simple slide-type safety that, when on, blocked the trigger with a thin piece of flat metal. However, some of these models fired with the safety on if enough pressure was exerted to the trigger. Some of them would go off quite easily and were certainly not safe in that condition.

In most cases, it's best to order a new safety assembly from the manufacturer. When this is impossible (obsolete weapons), new safeties can be made or available safeties can be modified. Once the principle of a safety is understood for a particular weapon, repairing it should not be difficult. In all cases, the safety either prevents the trigger from being pulled or prevents the firing pin from moving forward. The former method is used the most on, 22s.

Trigger Repairs

Since many single-shot bolt-action ·22-caliber rifles are designed to be built as inexpensively as possible (except for a few high-grade target rifles), most have creepy, heavy triggers which are powered by a spring arrangement that more properly belongs in a toy cap gun. These trigger assemblies use an inverted L-shaped protrusion on the trigger which acts as a sear. This protrusion bears against a notch or sear in the firing pin or striker. When the trigger is squeezed back against the spring pressure, the L-shaped extension disengages from the firing pin notch, permitting the mainspring to drive the firing pin forward to discharge the gun.

All types of springs are found in trigger mechanisms for the various ·22 rifles, and all can break after much use. Most can be replaced from packaged spring assortments sold by gunsmiths' supply houses. Helical and similar springs can be made from piano-wire spring stock. Common sizes run from ·020″ to ·045″ Flat springs can be made from flat spring stock, but they will have to be annealed and retempered. When a replacement is not available, try to obtain dimensioned drawings of the spring before proceeding. See Fig. 3-4.

Trigger mechanisms on some inexpensive singleshot ·22 rifles malfunction due to interference from the wooden stock. For example, the Winchester Model 60A single-shot uses a pin through the stock on which the trigger pivots and gets its "spring" from a flat spring applying pressure to a feeding/sear part. I recently repaired a stock for one of these rifles that had been broken completely in two under the action portion of the barrel. After the stock was repaired with fiberglass and refinished, the break was hardly noticeable. However, when the rifle was reassembled and tested, the fiberglass had lengthened the stock just enough to allow the nose of the trigger to slip out of its notch in the sear, causing malfunction. The trigger was removed and the curvature of the nose traced on a piece of paper for reference. Then a small piece of metal was silver soldered to the tip of the trigger nose and ground to the shape of the pattern traced on the paper. The weapon then functioned perfectly.

It is difficult to lighten the trigger pulls on most single-shot ·22 rifles because of the stiff springs that must be used to provide positive cocking. Improvements can be made, however, by honing all contact points smooth, then polishing. The springs on some of these guns can be lightened slightly, which in turn will lighten the trigger pull. Proceed in this direction with caution and have a replacement spring on hand in case you err.

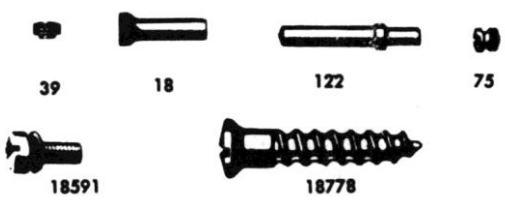


Figure 3-4: Obsolete gun parts are becoming harder and harder to locate. Every time you have the chance, make a sketch of an obsolete gun part and keep it on file for later use.

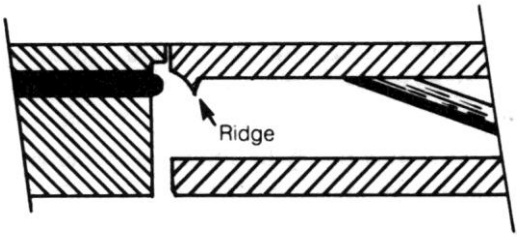


Figure 3-5: Dry-firing any ·22 rimfire rifle can force a ridge of metal into the chamber area.

Correcting Burred Chambers

Dry-firing any ·22 rifle can break the firing pin or also force a ridge of metal into the chamber as shown in Fig. 3-5. This ridge can cause feeding and extraction problems. Since the bolt may not close completely, headspace may be a problem leading to non-ignition or a ruptured case.

If care is used, a small bastard file may be used to remove the burr, but file only the ridge and don't touch any other portion of the chamber.

A safer way to remove the burr is to make a ·22-caliber ironing tool (Fig. 3-6). To use it, slide the tool into the chamber, using only moderate force, and rotate it. The flat blade side pushes the extruded metal back into position without any loss of chamber surface or change in dimensions.

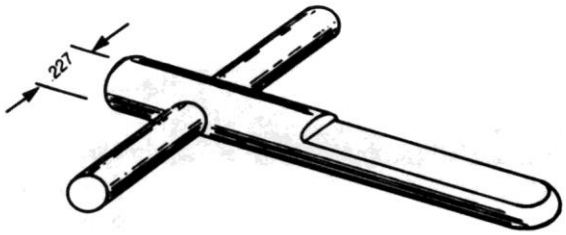


Figure 3-6: Twenty-two caliber ironing tool for removing burrs in chambers. To use, slide the tool into the chamber, using moderate force, and rotate it. The flat blade slide pushes the burrs back into position.

Damaged Muzzles

Occasionally you will run across a ·22 rifle that doesn't shoot accurately even though the rifling appears to be in excellent condition and the action and related mechanism are tight and functioning properly. Chances are rifling at the crown of the muzzle has become burred due to some sharp object striking it. Use a magnifying glass when inspecting.

The best solution to burred muzzles is to re-crown the barrel, cutting the barrel back about ⅛″. If a lathe is available, this is your best bet. Chuck the barrel in the lathe headstock and use a dial indicator or other gauge to make sure the barrel runs "true." Then, using a barrel-crowning lathe bit, take careful cuts until the proper degree of crown is cut

The crowning problem may also be solved by using a muzzle-crowning ball in either a hand or electric drill. For badly damaged muzzles, a rotary file may be used first to start the crown cut, and then a brass ball for lapping and finishing. Coarse and fine muzzle-crowning rotary files are readily available in diameters of ⅜″, ½ and ⅝″. The muzzle-crowning brass balls are available in 7/16″, 9/16″ and 11/16″.

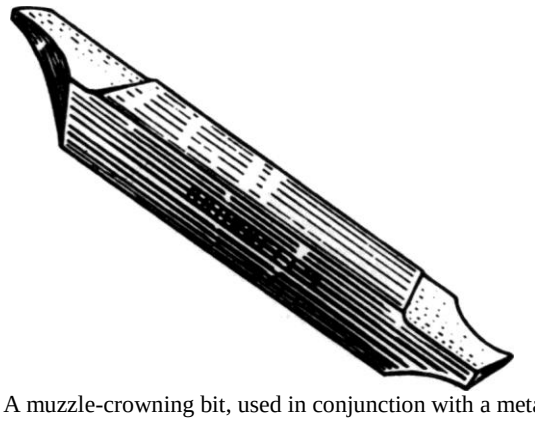


Figure 3-7: A muzzle-crowning bit, used in conjunction with a metal-turning lathe, is the normal way of crowning a rifle muzzle.

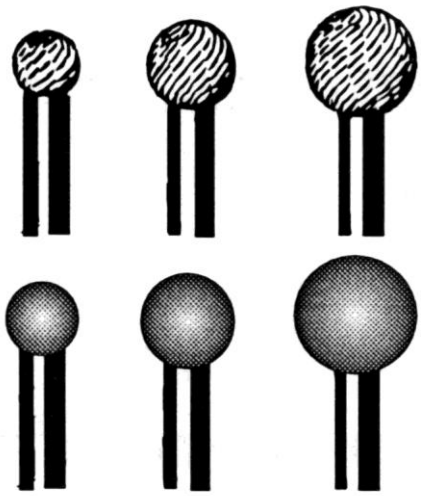


Figure 3-8: Rotary files and brass balls may be used to crown a rifle muzzle to eliminate any burrs that may be affecting accuracy.

Repairing Sights

Sights on the inexpensive ·22-caliber rifles usually consist of conventional dovetailed front-sight blades and ramp-type rear sights. The elevation is controlled by the rear sight and the windage corrected by the front sight. The only problem with these sights is losing them; that is, the rear sight elevator will get knocked out and become lost or the shoulders of the dovetail slot will become loose and the sight base will slip out.

If loose sight bases are noticed, the problem may be corrected in either of two ways. Peen in the shoulders of the dovetail slot until they are tight against the sight base. Remove the sight and, using a center punch, punch a series of craters in the bottom of the slot The raised metal will tighten against the bottom of the sight base.

The troubleshooting chart in Fig. 3-11 summarizes most of the problems and solutions of ·22-caliber single-shot bolt-action rifles.

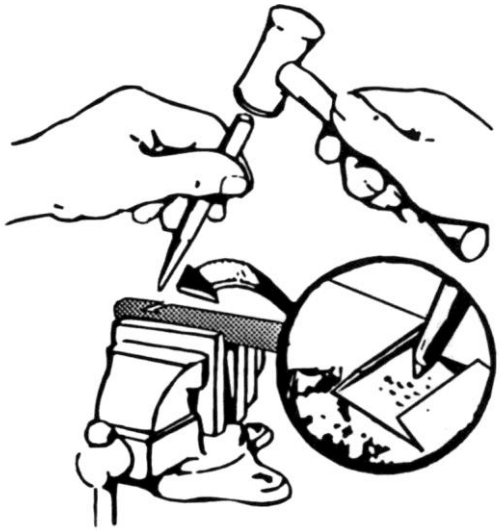


Figure 3-9: When a dovetail sight becomes loose, one way to tighten it is to remove the sight from its slot and punch a series of craters in the bottom of the slot with a center punch. The raised metal will tighten against the bottom of the sight base.

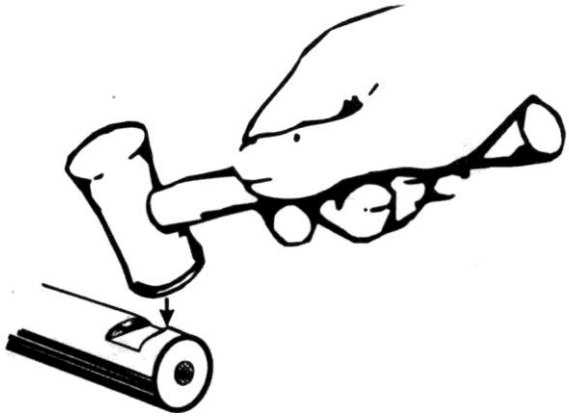


Figure 3-10: Peening dovetail-slot shoulders will also tighten the dovetail sight, but go slowly. A couple of light taps with a brass hammer should do it.

TROUBLESHOOTING CHART ·22 Caliber Rimfire Single-Shot Rifles		
Malfunction	**Probable Cause**	**Corrective Action**
Bolt closes hard	Rough chamber	Polish lightly
	Rough cam in receiver	Smooth cam
	Too little headspace	Adjust headspace
	Damaged extractor cut	Correct damage
Bolt follows down (does not cock)	Engagement of sear to connector locking or insufficient to hold	Adjust
	Trigger fails to retract	Adjust
	Damaged sear	Replace
	Connector damaged	Replace
	Sear and connector dirty	Clean
Fails to extract	Extractor damaged	Replace
	Faulty extractor grips	Adjust
	Extractor slot in barrel damaged	Repair slot or replace barrel
	Rough chamber	Polish lightly
	Fired cartridge bulged at base	Check headspace
	Fired cartridge bulged at mouth	Polish chamber or replace barrel
Misfires	Firing pin worn or broken	Replace
	Firing pin binds	Free up and clean
	Trigger assembly faulty	Adjust
	Mainspring damaged	Replace
	Ammo faulty	Discard ammo
Fails to eject	Damaged ejector	Replace or tighten
	Loose cartridge under extractor	Adjust grip on extractor
Bolt pulls out	Bolt-stop release damaged	Replace bolt-stop spring
	Bolt stop binds	Remove burrs and clean
Poor accuracy	Barrel crooked	Replace or straighten
	Barrel bore or muzzle damaged	Replace barrel

Figure 3-11: Troubleshooting chart for, 22-caliber single-shot rifles.

Chapter 4 - Slide-action Rimfire Rifles

You may prefer to call it “pump” or “trombone-action,” but by whatever name, ·22 rimfire slide-action rifles have been popular with American shooters since Winchester introduced their famous Model 1890 rifle. In fact, the slide-action was probably the most popular ·22 rifle in existence until the past couple of decades when semiautomatics started to take over.

Due to simplicity of the ·22 slide-action rifle, few will ever need any major repairs. When a malfunction does occur in a ·22 slide-action rifle, it will be similar to the ones described earlier for ·22 single-shot, bolt-action rifles. In addition, since ·22 slide-action rifles are repeaters, you will run across feeding problems caused by dents or debris in the magazine tube; worn or broken magazine springs; bent, broken or blocked cartridge stops and cut-offs; or worn carriers or carrier cams. But before you can accurately repair slide-action rifles, you must first understand how they operate.

Operating Characteristics

All ·22 slide-action rifles use the forearm, which is attached to the action bar, to operate the repeating mechanism. A quick movement of the left arm backward (for right-handed shooters) extracts and ejects the fired cartridge case, allows the magazine spring and follower to push a new cartridge in line with the cartridge carrier, and lifts the cartridge so that the bolt assembly will pick up the new cartridge and push it into the chamber when the slide is returned (pushed forward) to its original position.

The hammer or striker is cocked on slide-action rifles when the slide-bolt assembly is pushed to the rear and is held in this position by a special sear that fits into a notch in the hammer or striker. When the bolt reaches its extreme forward position, a special locking block closes into position, locking the action-making it ready for firing.

Common Malfunctions

Burred or scratched chambers and peened muzzles are quite common. Since slide-action rifles are repeaters, they are especially prone to hang-up because of hardened grease and foreign matter in the receiver and extractor recesses. Here, the problem is compounded by the lubed ammunition used by most shooters and by the comparatively small size of the various action recesses.

Faulty extraction and ejection are most often related to badly fouled or burred chambers (usually caused by dry firing) or by jammed extractor springs.

Many problems associated with ·22 slide-action rifles can be solved by a thorough cleaning and degreasing, so make this operation your first before any diagnosis or repair work begins. Ship the gun down to its basic action components and clean and degrease them thoroughly. Once the parts are clean, those requiring replacement or touching up are fairly easy to detect

Failure to Feed

Most ·22-caliber slide-action rifles have tubular magazines which are subject to denting, in turn causing misfeeding. Therefore, when a slide-action rifle has feeding problems, first check over the magazine tube for dents, rust, or corrosion. Dents should be readily noticeable after a thorough cleaning and can be removed by inserting a steel rod of near tube diameter into the magazine, then hammering the dented area with a brass hammer over a piece of leather. Light taps around the dented area will raise the dented metal. Rusted or corroded magazine tubes are corrected by cleaning.

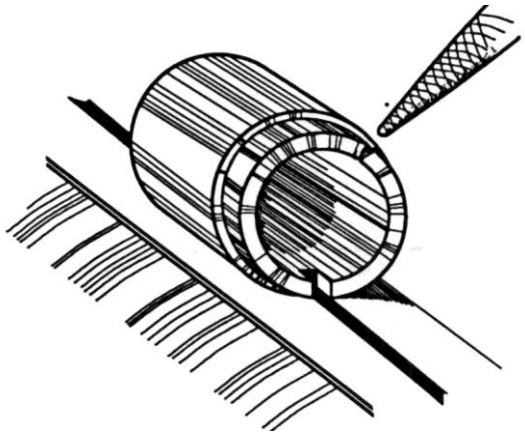


Figure 4-1: Peened cartridge cut-off retainer for a Winchester Model 61 caused feeding problems in this slide-action.

A weak, rusted, or badly bent magazine spring can also cause feeding problems. A weak spring can usually be diagnosed and temporarily corrected by stretching or by inserting a small wooden dowel in the spring compartment to compress the spring more. If either of these techniques corrects the feeding problem, install a new spring.

Sometimes the cartridge stop will catch the cartridges at the front end of its incline. This can be corrected by reducing the bevel at the lower front end of the cartridge stop. If the cartridge does not feed through the action bar, remove the cartridge stop and grind off only enough metal at point "A" (Fig. 4-2) to allow the shell head to pass over. If cartridges do not feed up the incline of the cartridge stop but catch on comer "B" (same figure), the beveled surface should be cut lower at "B" and tapered to nothing at "A" before polishing smooth.

If feeding fails from the action bar to the breechblock guideways, the lug of the breech block has been cut away too much at its incline (where the action bar engages) to move the block forward. This allows the action bar to move cartridges too far forward in relation to the breechblock. Since it is very difficult to replace removed metal, a new breechblock should be fitted if this is the problem.

If the failure is from the bottom of the breechblock to the barrel, check the guideways in the face of the breechblock. They are probably too wide if this problem occurs, allowing the cartridge head to fall out. The solution is to fit a new breechblock.

Another cause for this problem is the firing pin is held too far forward by the ejector spring, causing the shell head to catch on the bottom of the firing pin point Bend the ejector spring front prong slightly toward the rear of the rifle. This should correct the problem.

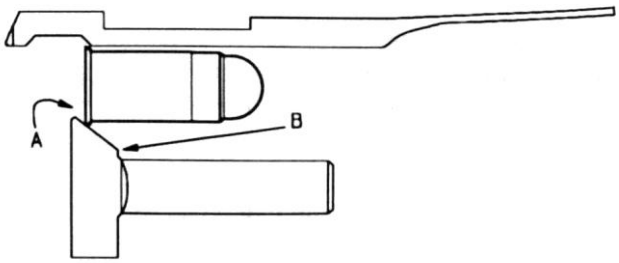


Figure 4-2: Sectional view of cartridge stop for Remington Model 121.

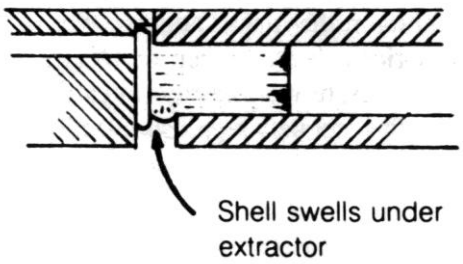


Figure 4-3: When the extractor clearance cut in the barrel is too deep, cartridges will swell under the extractor and cause it to slip off the rim of the cartridge case.

Extraction and Ejection Problems

The most probable cause of faulty extraction in ·22 slide-action rifles is either a faulty dull extractor claw or a weak extractor spring. The former problem can be corrected in most instances by sharpening the claw. The latter problem is corrected by replacing the weak or broken spring.

At times, the extractor clearance cut in the barrel is too deep (Fig. 4-3), allowing shells to swell under the extractor and causing them to slip off the rim of the cartridge cases. Fitting a new barrel is the best solution, although the extractor slot can be built up and recut.

Dry-firing a ·22 rimfire rifle can cause a ridge or heavy burr to protrude into the chamber (Fig. 4-4). If such a burr is present, ream out the burr from the chamber as it will hinder, if not completely prevent, extraction. The ·22-caliber ironing tool, as discussed previously, will work most of the time, but the problem may require the use of a chambering reamer.

If the extractor has too much space between the claw and the face of the breechblock, the spent cartridge may not eject (Fig. 4-5). The extractor lug can sometimes be bent to shorten the space at the claw. When doing so, however, extreme caution must be used to prevent breakage.

Another cause of ejection failures is an improperly fitted or worn firing pin. The fitting of a new firing pin will normally cure the ailment.

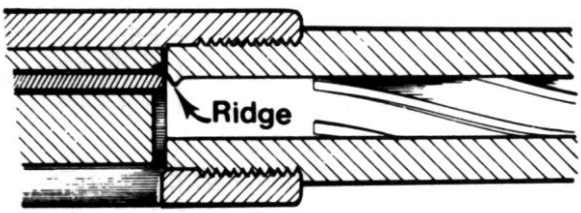


Figure 4-4: Dry-firing a ·22 rimfire rifle can turn a heavy burr into the chamber, causing extraction and ignition problems.

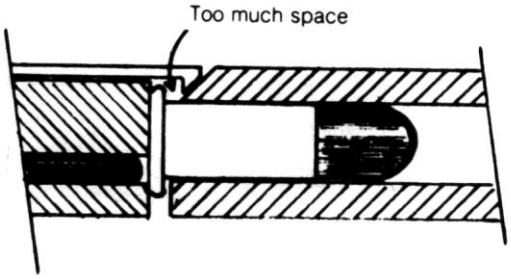


Figure 4-5: Too much space between the claw and the face of the breechblock may prevent fired shells from ejecting.

Action Failures

When the action fails to release when fired, the carrier probably does not rise high enough at the front end to clear the carrier dog. To remedy, adjust the mainspring rod by bending its middle slightly down where it engages with the rear of the carrier.

Action fails to lock forward when arm is cocked: This problem is just the opposite of the former one and is caused by the carrier not going down far enough at the front end to engage property with the carrier dog. Remove the carrier and cut away some metal from the carrier where it rests at the front end of the guard.

Also check for rounded comers on the carrier where it engages the carrier dog. If this is causing the problem, a new carrier will have to be fitted. By the same token, check for rounded comers on the carrier dog. If this is causing the problem, a new carrier will have to be fitted. By the same token, check for rounded comers on the carrier dog itself and replace if necessary. Finally, inspect the carrier dog spring and replace it if it is weak or broken.

Breechblock starts forward hard: Inspect the gun to see if the recoil lug of the breechblock is catching into the well hole in the rear top of the receiver (on some rifles) which is slightly rounded at the comer. If so, peen the metal of the receiver to make the front comer of the well hole reach farther toward the rear, or fit a new breechbolt.

Carrier fails to lift cartridges when action is moved forward: The most probable cause is a weak or broken carrier-dog spring, which should be replaced if found defective. The carrier dog itself may be the culprit If it is badly worn or broken, refit a new one.

Cartridge strikes edge of chamber: If this problem occurs, first thoroughly clean the rifle; dirt under the extractor is probably preventing the extractor from swinging far enough toward the cartridge. Once cleaned, check the space between the extractor claw and the face of the breechblock. If excessive, bend the lug of the extractor forward to shorten the distance. A dirty or gummed-up extractor spring could be causing the problem, but the initial cleaning should solve this problem. If not check for a weak or broken spring and replace if necessary.

Failure to Fire

On pumping the action, sometimes the hammer will not stay cocked. This is more than likely caused by a broken hammer notch. Disassemble, check the hammer, and replace it if necessary.

Continue the check by looking for broken or worn firing pins, mainspring, etc. Replace all broken or worn parts.

The cartridge-supporting surface at the end of the barrel where the firing pin strikes can become upset (Fig. 4-6). When this problem occurs, the shell rim is allowed to bend as the firing pin hits and, in many cases, will not puncture the primer.

Also check for dirt and debris in the receiver grooves which could prevent the action from locking completely. This, of course, will prevent the cartridge from firing, or if it should fire, escaping gases may endanger the shooter.

Firing-pin length and condition are also important to ignition and to preventing damage to the action or the chamber.

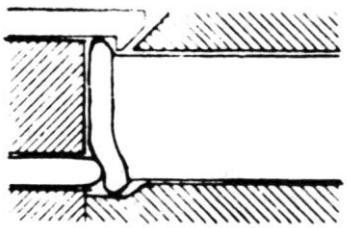


Figure 4-6: The shell-supporting surface at the end of the barrel — where the firing pin strikes — can become upset, causing the shell rim to bend upon firing and fail to ignite.

If a worn or broken firing pin is suspected, disassemble the bolt and inspect the firing pin tip or striker. If it is broken, it is best to install a factory replacement If time is critical or a new pin isn't readily available, a new tip can be welded on, dressed to size, and heat treated to harden. By doing so, however, the customer's expense will increase dramatically.

It is a good idea to stock an assortment of firing pins for the more popular guns. Although the time required may be prohibitive, replacement firing pins can often be made in the shop using the old pin as a guide — especially if you own a lathe. Firing pins for almost every gun can be made on such lathes.

The troubleshooting chart below will prove helpful in repairing slide-action rimfire rifles of all types.

TROUBLESHOOTING CHART
·22 Caliber Rimfire Slide-Action Rifles

Malfunction	**Probable cause**	**Corrective action**
Fails to extract	Broken or weak extractor spring	Replace
	Dull extractor	Sharpen claw
	Rusted or pitted chamber	Polish or fit new barrel
Fails to eject	Dull extractor	Sharpen claw
	Weak extractor pin	Replace
	Broken ejector	Replace
Failure to chamber	Dirty extractor	Clean
	Weak extractor spring	Replace
	Carrier dog too short	Replace
Failure to feed	Dirty or dented magazine tube	Clean and/or remove dents
	Weak magazine spring	Replace
	Carrier lever too short	Replace
	Cartridge stop defective	Replace
	Action bar too loose	Replace

Figure 4-7: Troubleshooting chart for rimfire slide-action rifles.

Chapter 5 - Lever-Action Rimfire Rifles

The lever-action rimfire rifle was introduced in 1884 when Winchester chambered their famous Model 1873 rifle for this cartridge. Marlin followed with its Model 1891 in ·22 rimfire. For years, these were the only two lever-action rifles chambered for the ·22 rimfire, except for certain rare, custom or special-order rifles.

The Marlin Model 91 was a side-ejection, tubular-magazine, lever-action repeater which held up to nineteen short or fourteen long rifle cartridges. The rounds were loaded into the gun through a spring-actuated cover on the right side of the receiver, which could be removed from the breech for inspecting and cleaning the bore.

A short time after its introduction, the Model 91 was modified to permit loading the round from the front of the tubular magazine. Capacity was increased to hold twenty-five short or eighteen long rifle cartridges. About the same time, a small number of Model 91's were offered in a ·32-caliber chambering, with interchangeable firing pins for use with ·32-caliber rimfire or centerfire cartridges. Barrels for the early Model 91's were available in several lengths and in a choice of round, half-octagonal, or full-octagonal.

The Model 91 was soon replaced by the Model 92, which incorporated some minor changes. The Model 92 had an integral sear and trigger, while the sear and trigger components on the Model 91 were separate. There were also slight modifications in the firing pin, breechbolt, and trigger spring.

A takedown version of the solid-frame Model 92 was introduced in 1897. A notable variation of the Model 97 was the special Bicycle Model with a 16-inch barrel and a short magazine. Production of both the Model 92 and the Model 97 was discontinued in 1915 when the Marlin Company sold out to a firm manufacturing machine guns for the United States and its allies. After World War I, the company tried to convert to sporting arms production but failed and went bankrupt After the sale of the firm's assets, the new management discovered a stockpile of pre-war Model 97 parts. Production was started on the new Model 39 (made from Model 97 parts), which differed from its predecessor primarily with its pistol-grip stock, beavertail forearm, and tapered round 24-inch barrel. See Fig. 5-1. The company, elated over sales, became the new Marlin Firearms Company.

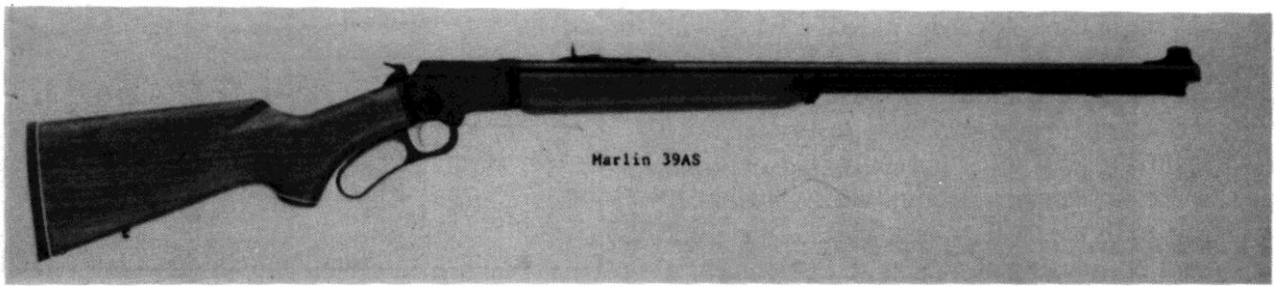


Figure 5-1: The latest version of the Marlin Model 39 lever-action rimfire rifle.

Commencing in 1954 and with the introduction of a carbine with a 20-inch barrel, the Model 39 became the Model 39A. This gun had a straight-grip stock and a reduced-capacity magazine. Since then, Marlin has introduced a number of variations on the basic 39A design. All, however, are essentially similar to the Model 1892.

In recent times, other ·22 rimfire lever-action rifles have entered the scene. Winchester introduced its Model 250 and later its popular Model 9422 (See Fig. 5-2). Browning followed suit, and so did Erma. Still, the handful of different lever-action rimfire models is relatively insignificant when compared to bolt actions, pumps, and semiautomatics.

Common Malfunctions

All ·22 rimfire lever-action rifles use tubular magazines, and feeding problems often occur due to dented, dirty, or corroded magazine tubes.

Weak or broken magazine springs are another cause of misfeeding in these rifles. Recesses in the receiver of lever-action rifles, just like in slide-action, 22's, collect dirt and debris that lead to feeding problems. The remedy is the same as for all other tubular magazine guns suffering from this problem — thoroughly clean the tube, remove the dents, and replace the magazine spring.

Twenty-two caliber rifles seemed to be the most abused guns of all next to the single-barrel shotguns. In some cases, one or two lands at the end of the barrel will be peened inward and cause the barrel to be highly inaccurate. When a ·22 rimfire that doesn't shoot accurately is encountered, examine the muzzle very carefully with a magnifying glass to see if a land or two has been damaged. The problem can be corrected by sawing off a small portion of the barrel — just ahead of the front sight — and recrowning the muzzle. Sometimes, a crowning tool (Fig. 5-3) alone will solve the problem without using the saw. Chuck the barrel in a lathe and. using a crowning tool, cut the crown back about 1/16″; more if the defect is deeper.

The Martin Model 39A has a takedown feature that often causes the joints to loosen. These actions can be tightened, but extreme care must be taken to correct this problem. The object is to move metal, by peening, so that the sliding parts will fit closer in their recesses or grooves. Many owners of takedown ·22s try tightening the takedown screw itself by using a pair of combination pliers or else by using vise pressure, but this seldom helps matters. The opposing male parts must be adjusted by either stretching or widening to gain the desired fit.

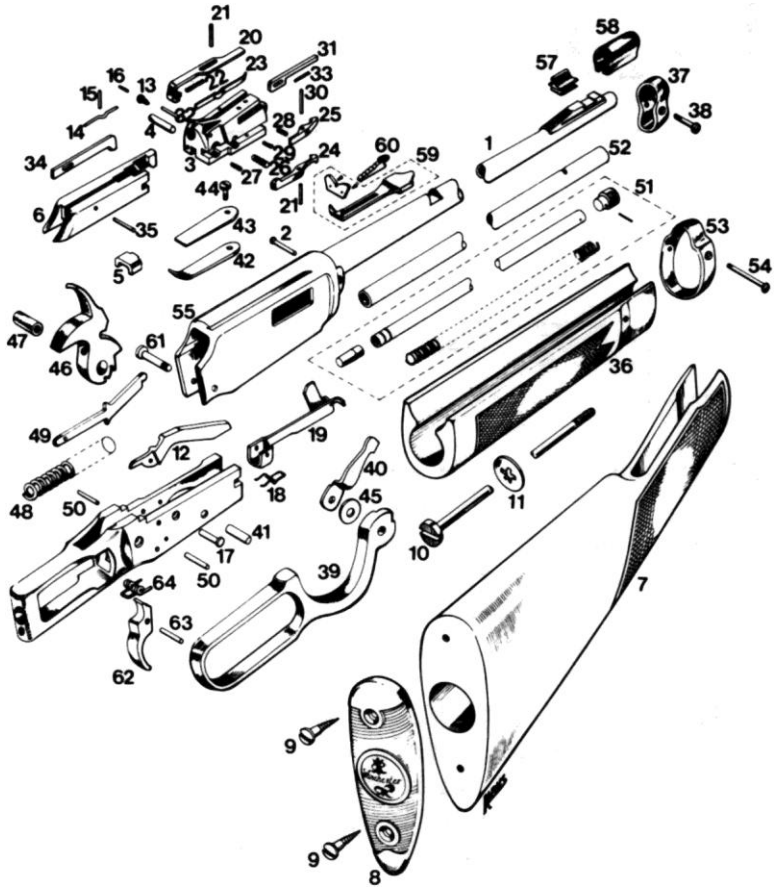


Figure 5-2: The Winchester Model 9422 has become quite popular over the past 20 years. The gunsmith, however, will probably see more Marlin 39s in his or her shop.

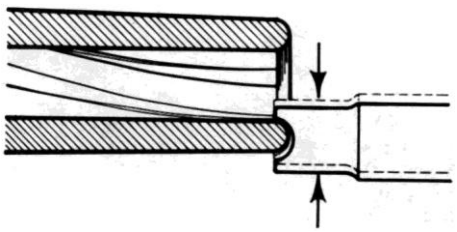


Figure 5-3: A crowning tool will often repair the muzzle on ·22-caliber rifles without any additional work.

Ithaca Model 72: This is another ·22 rimfire rifle that resembles the Winchester or Marlin rifles. To disassemble, remove the stock and four side screws in the receiver, then lift the receiver and upper tang off the main frame of the gun, exposing the bolt (in the top frame) and the remaining parts in the lower frame. The rifle is of good basic design and few problems should exist with this model.

Marlin Model 39A: Most springs in the Model 39A are relatively free from a great deal of flexing; therefore, breakage is rare. One exception is the ejector spring, which is subject to flexing every time the action is cocked. Because of this, the ejector spring on the Marlin Model 39A will let go occasionally. Another spring that will sometimes break is the cartridge guide spring mounted in the top of the receiver. This spring is flexed upward each time the action is closed, and eventually — after much use — it will break at the screw hole. Replacement of this spring is relatively easy, as the screw enters from outside the action and threads directly into the spring. However, be very careful not to crossthread this tiny screw during the installation.

The top surface of the lever arm, where it mates with a corresponding angled surface on the underside of the breechblock, sometimes becomes worn after many thousands of rounds have passed through the rifle. This causes the breech to not close tightly. This problem may be corrected by building up the top of the lever arm with a steel weld and then recutting it to fit. Of course, this surface should be rehardened before the final installation

Occasionally the cartridge cut-off will become wedged against the upper edge of its recess in the receiver. Since there will then be nothing to stop the next round in the magazine, the gun will invariably jam. To correct, loosen the cartridge-stop screw, carefully center and hold the cartridge stop in its recess, and retighten the screw.

Although the firing pin for the Marlin ·22 looks very simple, a broken pin should be replaced with a factory replacement. Its several projections and planes are precisely related to the lever and breechblock and are difficult to obtain in the shop.

Marlin Model 57M Levermatic: This ·22 rimfire lever-action rifle was introduced in 1955 and featured an enclosed-hammer design and a very short lever stroke — entirely different from the Marlin Model 39A. Replacing parts of this gun is not for amateurs, as it involves dealing with several small pinned parts. The most frequent problems will occur with the cartridge guide, extractor, and firing pins.

Remington Nylon 76: Remington Arms Co. introduced this ·22 lever-action rifle in 1962. It featured a short-stroke lever which enabled it to be operated at a much faster speed than most of the longer-stroke lever-action rifles. However, the rifle was discontinued and only its close cousin — the Nylon 66 semiautomatic rifle — gained much popularity.

The Nylon 76 should not be disassembled by the novice unless you have an exploded view and detailed instructions at your fingertips. When this gun is first opened, it strongly resembles a cheap Taiwan toy consisting of sheet steel parts and expansion coil springs, very few of which make any sense at first glance. However, the gun is a carefully engineered design that functions well with little maintenance.

There are three basic part groups that are subject to breakage — the safety lever, the springs, and the disconnector. When replacing any of these parts, try not to release the striker because you will take a lot of time and patience repositioning this once it is released. Remington's "Field Repair Manual" should be referred to when working on this model.

Winchester Model250: Here's another hammerless ·22 lever-action rifle that was made for a relatively short period of time, then discontinued. In general, the Model 250 is a relatively trouble-free rifle as long as no adjustments — like adjusting the trigger pull — are made. For example, the cartridge feed guide is made of very lightweight steel and it must be just right for proper feeding. Any attempt to alter the shape of this part usually requires a replacement.

The wearing quality of this gun is not the best, and reports indicate that parts begin to wear out after a couple of thousand rounds or so — probably one reason why this model was discontinued.

Winchester Model 9422: This rifle was introduced in 1972 as a small-caliber companion to the popular Model 94, and there is a close external resemblance to the two models. The cartridge feed system of this rifle utilizes a tubular magazine under the barrel and is very similar in operation to an earlier Winchester design, the Model 61 slide-action rifle— except the slide is replaced with a finger lever.

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weak extraction systems. There are also many other similarities in basic trigger assemblies and safety design. Therefore, feeding and lock-up problems will be similar in both types.

The troubleshooting chart in Fig. 5-4 shows some of the more common problems that develop in lever-action rimfire rifles. However, try to obtain additional troubleshooting data for each gun from the factory.

TROUBLESHOOTING CHART
·22 Caliber Rimfire Lever-Action Rifles

Malfunction	**Probable cause**	**Corrective action**
Fails to extract	Broken or weak extractor spring	Replace extractor spring
	Dull extractor	Sharpen extractor claw
	Rusted or pitted chamber	Polish or fit new barrel
Fails to eject	Dull extractor	Sharpen claw
	Weak or broken extractor pin	Replace
	Broken ejector	Replace
Fails to feed	Dirty or dented magazine tube	Clean and/or remove dents
	Weak magazine spring	Replace spring
	Carrier lever too short	Replace
	Cartridge stop defective	Repair or replace
	Action bar too loose	Tighten or replace
Fails to fire	Broken or worn firing pin	Repair or replace.
	Weak mainspring	Replace
	Carrier lever too short	Replace
	Dirty firing-pin assembly	Clean
	Action bar too short	Replace or lengthen

Figure 5-4: Troubleshooting chart for rimfire lever-action rifles.

Chapter 6 - Semiautomatic Rimfire Rifles

The first successful ·22 rimfire semiautomatic rifle used a blowback design; that is, when fired, the barrel remains stationary while the bolt or breechblock moves to the rear under the force of push from the exploding cartridge. With few modifications, the same principle is used today. Since the breechblock is heavier and is also held by a spring, the fired bullet—moving at a much faster velocity than the breechblock—leaves the muzzle before the block is moved to the rear. While the breech is being thrown open by the force of the fired cartridge, it ejects the empty cartridge case. When the spring finally stops the breechblock, it starts it moving forward to pick up a new cartridge from the cartridge lifter and pushes the cartridge into the chamber. The movement of the breechblock also cocks the hammer so that once the breech is in the forward position, the rifle is ready to fire again. This sequence of operation and firing can be continued until the magazine is empty.

Some ·22-caliber semiautomatics with badly worn parts can fire fully automatic, creating dangerous and highly illegal firearms. Most, however, incorporate a disconnector that holds the hammer back and prevents it from following the barrel to the firing position — making a separate trigger pull necessary for each shot.

If one were to list all of the potential trouble sources and adjustment-repair sequences for all semiautomatic rimfire rifles, he would wind up with a sizable volume. However, the similarity in function (and malfunction) of the various semiautomatics is more pronounced than the design differences. While such guns generally fail more often than guns of other designs (bolt actions, slide actions, etc.), the reasons for the malfunctions can be weeded out and are usually not difficult to correct.

Since the blowback system depends on spring tension and the weight of the breechblock for proper operation, the power of cartridges used in the guns with this type of mechanism must be limited. Therefore, this system is usually limited to cartridges of ·22 caliber rimfire power and also pistol cartridges up to the ·45 ACP in size.

Cleaning Takes Care of Many Problems

The most common malfunction found with semiautomatic rimfire rifles is misfeeding. At least nine out ten of these rifles come into repair shops with feeding problems, sometimes due to a weak magazine spring or a worn or broken cartridge lifter. However, a dirty action is probably the most common cause of misfeeding. Therefore, some general hints on cleaning ·22 caliber semiautomatic rifles are in order.

Part of the pleasure of handling a gun is the proper function of it. Part of the responsibility of owning a gun is its proper maintenance and care.

Maintenance and care arc necessary to keep a gun in a reliable, safe, operating condition. A gun that is rusty and dirty won’t look good, may not operate properly, and may actually be unsafe.

The cleaning of a firearm at regular intervals takes only a few minutes and insures accuracy, good working order, and a long-lasting gun finish. On the other hand, a neglected firearm will be difficult to clean and will often be badly pitted — sometimes beyond repair. Therefore, if shooters keep their guns in first-class condition at all times, they can expect them to function properly and last several lifetimes.

Weapons firing cartridges with smokeless powder and noncorrosive primers need not be cleaned immediately after firing. But don’t put the job off any longer than necessary because the chances of rust forming increase with time. A pitted bore can render a rifle useless.

All that is required to clean a firearm is one of the basic cleaning kits available on the market. These kits contain a cleaning rod, rod tips, oil, powder solvent, and gun patches. Some include a wire brush. These kits are compact and easily transported to the field for cleaning weapons immediately after a hunt or while on the range.

Most of the parts of a gun are made of steel, and many of them are blued. In any event, whether blued or not, all the metal parts need a light protective coat of oil to prevent rust from atmospheric conditions. When a gun is being used on the range or carried in the field, the oil should be wiped off so it won’t gather dust and dirt But the oil should again be applied to the gun when it is returned to the gun rack. It is also a good idea to have a silicone cloth or else a very lightly oiled wiping rag stored in a metal container near the gun so that finger marks can be wiped off after the gun has been handled. The salty perspiration from fingers and hands is very likely to cause rust.

Like any other piece of machinery, the gun’s mechanism should occasionally be cleaned and lubricated. A gun that is used in the field will get dusty, and some of this dust will get into the working parts. During shooting, bits of unburned powder or carbon may work their way into the action. Previous lubrication will dry up and get gummy or sticky. If a gun is used much, the mechanism should be cleaned rather often. But if it is not used much, a cleaning once a year should be enough.

Before you start to work on a gun or clean it, be sure that it is unloaded and there is no ammunition in the magazine.

Be very careful to follow the maker’s directions in taking the gun apart and putting it back together again. It is not necessary to take it down to the last pin and part, but only far enough so that it can be cleaned properly. The less you take apart, the better off you are.

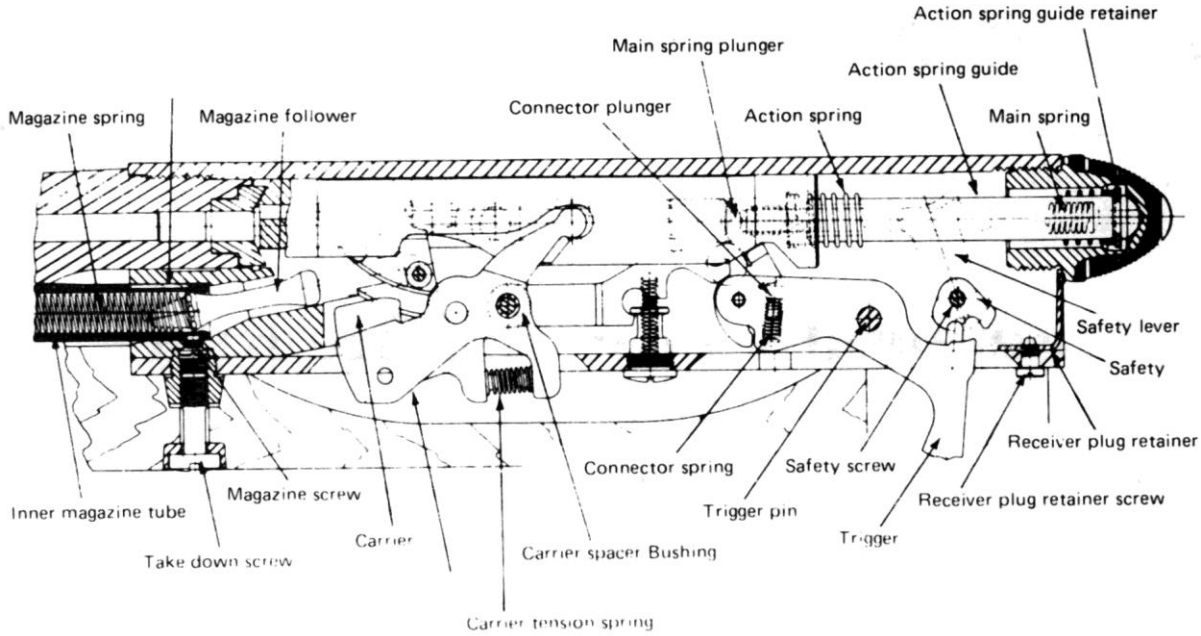


Figure 6-1: Basic components of a Remington Model 550 semiautomatic rimfire rifle. This model was one of the first rimfire semiautomatic rifles to use Carbine Williams' floating chamber to be able to shoot ·22 Short, Long, and Long Rifle cartridges interchangeably.

Basic Gun Cleaning

The first step to basic gun cleaning is to open the gun's action, inspect the chamber and magazine, and remove any ammunition from the gun. Leave the action open during the cleaning operation. If at all possible, always insert the cleaning-rod tip into the breech end of

Note: The following sentence is exactly as in the original, I do not know what is missing.

of an inch of a rifled barrel is very important, as any wear at all will reduce the rifle's accuracy. Another reason for cleaning any gun from the chamber end toward the muzzle is to keep debris out of the receiver. If you clean from the muzzle to the chamber, the cleaning patch will push all the gunk out of the bore and right into the action, making additional cleaning necessary.

Most semiautomatics will have to be disassembled to clean them from the breech end, or else the tip must be inserted into the muzzle end of the barrel. One possible way to avoid disassembling the gun and still be able to insert the cleaning tip from the chamber end is to use a flexible cleaning rod. This is nothing more than a long, heavy coil spring that allows bending. In either case, the action must be opened before the cleaning operation begins.

Barrels are usually easy to remove from semiautomatic rifles for cleaning; just follow the manufacturer's field-stripping (basic disassembly) instructions exactly. With few exceptions, most barrels on modern semiautomatic rifles are not threaded; rather, they are held in place with one or two retaining pins. Once the rifle is disassembled, driving out these retaining pins with a drift punch will release the barrel so it can be removed from the receiver.

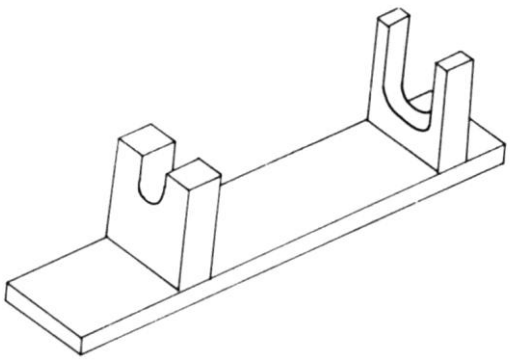


Figure 6-2: Simple gun-cleaning rack that can be made from scrap lumber.

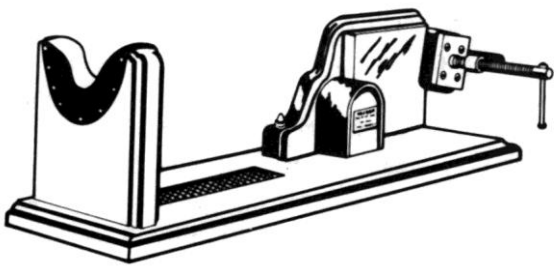


Figure 6-3: The Decker shooting vise is excellent for gun cleaning, as well as bore-sighting and other gun maintenance.

To use a gun-cleaning kit, soak a gun patch in powder solvent (bore cleaner) and push the patch through the slotted tip attached to the end of the cleaning rod. Insert the tip into the barrel from the breech end, if possible, and run the patch the full length of the barrel. This first patch usually contains the bulk of the loose residue in the bore, and if you pull it back through the barrel on the return stroke, you will redeposit some of it back in the bore. Therefore, always discard the first patch when it comes out the muzzle (the chamber if you have to insert the tip into the muzzle end). Insert a new patch through the slotted tip, saturate it with bore cleaner, and again run the patch the full length of the bore, and back again. Repeat this operation as many times as necessary, usually fifteen or twenty times. Then use a dry patch to dry the bore. Change patches often until the last one comes out clean and dry. Finish the bore cleaning by lightly oiling a clean patch and running it up and back through the bore.

Extra-dirty bores require the use of a bronze bristle brush. Soak a clean patch with powder solvent (bore cleaner). Push the patch through the slotted tip of the cleaning rod and run it up and down the bore until the bore is saturated with the cleaner. Remove the slotted patch tip from the cleaning rod, insert the brush, and dip it into the powder solvent. Then push the brush up and down the bore about a dozen times to loosen the dirt and grime. Finish by drying the bore with clean patches until the last patch comes out clean and dry.

The outside of the gun should be wiped off with a silicone cloth to prevent rust and corrosion and it will also remove finger prints and eliminate salt spray damage. This cloth may also be used on the gunstock.

The receivers of semiautomatic firearms collect all sorts of debris and foreign matter and must be cleaned periodically to insure proper functioning. An old toothbrush or Brownell M-16 cleaning brush can be used to get into actions and other hard-to-reach places. A squirt or two of WD-40 (a standard cleaner) sprayed into the action, followed by a good scrubbing with the brush will do wonders to keep actions clean and in first-class operating condition.

When cared for as described, guns will rarely be injured from rust, fouling, or corrosion from routine handling by human hands.

Firearms can be held for cleaning in a conventional bench vise as long as padded vise jaws are used to protect the finish. Furthermore, guard against tightening the vise jaws too much as you can bend receivers and damage other parts. When using a bench vise, clamp the firearm into the vise in a horizontal position with the butt resting on the bench top. You will then have access to the bore for pushing a cleaning rod through it. Some shooters prefer to clamp the rifle in a vertical position with the butt resting on the floor directly under the vise.

For very little expense you can build a suitable gun-cleaning rack similar to the wooden cleaning racks made available at one time to all military recruits. Two blocks, cut from either a 2 x 6 or 2 x 8 wooden board are merely nailed or screwed to a baseboard the same width as the blocks. You can also make a simple wood vise with a 2 x 4-inch piece of pine wood by drilling a hole to fit the barrel through the narrow sides of the wood member, and then slitting it. These were merely notched, wooden frames that held rifles securely while they were being cleaned.

If you don't care to go to the trouble of building your own, the Decker shooting vise is reasonably priced and greatly simplifies the operation of gun cleaning. When used properly, all scratching and marring are eliminated because the Naugahyde covering over the sponge padding is all that comes in contact with the gun. The base can be permanently mounted to a workbench or secured with C-clamps. This vise can also be used when bore-sighting, mounting scopes, and zeroing or adjusting sights for rifles.

Complete Gun Cleaning

The procedures described previously are fine for day-to-day cleaning of firearms, but once or twice a year (more frequently when the gun is used in adverse weather conditions) the gun should be partially disassembled and given a thorough cleaning. Complete cleaning will help to eliminate malfunctions that continually occur due to a buildup of sediment in the action of semiautomatics.

Brownell's d'Solve Gunsmith Cleaner is an excellent, non-hazardous, nonflammable, odor-free, and inexpensive — just the thing for curing feeding problems in semiautomatic rimfire rifles. Available in one-gallon containers, which makes five gallons of bench cleaner, it can be mixed stronger for tough jobs and diluted for less demanding cleaning operations.

It is simplest to use a clean, plastic bluing tank such as those supplied by Birchwood Casey. If one of these is not available, buy a 4-foot length of 4-inch PVC (plastic) pipe, an end cap and some joining compound from your local plumbing supplier. Cap one end of the PVC pipe and set it in a vertical position. Filled with the cleaning solution, the gun parts can be dipped into it and allowed to soak while you do other jobs around the shop. The grimiest parts will come out clean, ready to dry, oil, and assemble.

When used as a brush-on cleaner, the cleaning solution rapidly rids actions and chambers of crusted dirt and grime. Some cleaner on a toothbrush will clean old checkering, and a small amount on a pad wiped across a gunstock will remove grime. If the gun is going to be soaked, however, remove all wood first.

If you have compressed air available, use it to blow loose grime from the gun immediately after it is lifted out of the tank. Set the pressure at about 50 psi and let it do the work for you. Compressed air is also excellent for drying wet gun parts.

Malfunctions

Feeding problems: In tubular-magazine ·22 semiautomatic rifles such as the Stevens Model 87-A rifle, the cartridges are cammed up for feeding by a lifter or carrier actuated by the bolt. As the bolt rebounds forward under spring pressure, after being blown back by the fired cartridge, it cams the carrier up in its track to position a new cartridge so the bolt can pick it up and push it into the chamber. These grooves often become worn, binding the carrier and resulting in the action jamming. A replacement operating slide is the answer.

The cartridge lifter or carrier is another frequent source of trouble. This is the device that lifts the cartridge from the magazine tube up to the feed lips so the cartridge can be picked up by the bolt on its return or forward movement. Its movement on Savage ·22 semi-automatics is controlled by two lobes on top of its pivot end, and any wear on these can cause trouble with the feeding. A worn lifter will either fail to depress far enough for a cartridge to enter the magazine guide or fail to rise far enough for a cartridge to enter the feed lips.

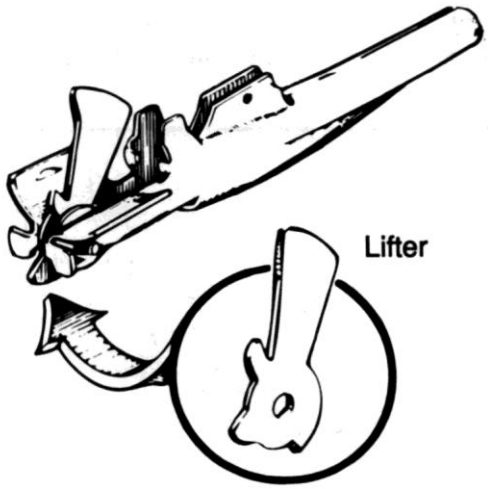


Figure 6-4: A new cartridge lifter will often cure feeding problems in Savage/Stevens semiautomatic rifles.

A lifter spring is another potential source of trouble that can cause misfeeding and jams. When the spring is weak, it does not depress the carrier far enough to permit feeding cartridges from the tube into the action. A replacement is the only answer.

Broken or bent cartridge or feed guides also cause feeding problems. On the Savage rifles, the cartridge guide is made of formed sheet steel, and the ejector is an integral part of the guide. Should the ejector become worn or broken, the entire guide must be replaced. If the guide is only bent, needle-nose pliers may sometimes be used to correct the situation, except when the part is cast

The disconnector system on the Savage ·22s can be somewhat tricky, as the spring tension in this system is critical—resulting in feeding problems, fully automatic firing, etc.

Failure to Fire: When a semiautomatic rifle fails to fire, the cause is most often due to debris and foreign matter in the bolt which prevents the firing pin from moving forward the proper distance and/or at the proper speed. Complete disassembly and degreasing is the solution for this problem.

The firing pin may be rusted at the front end or broken off completely. In either case, a new firing pin should be installed. Also check the mainspring and replace it if it's weak or broken. Here are some other probable causes of misfires:

- Check the protrusion of firing pin. It should be at least 1/16″.
- Check the extractor for binding.
- Check the extractor for burrs.
- Check the extractor cut in barrel for burrs.
- Check the extractor cut in barrel to be sure extractor lines up and isn't hitting the edges of the cut due to a slight rotation of barrel.
- Check the striker for burrs.
- Check the firing-pin assembly to be sure the ejector and its spring can move freely.

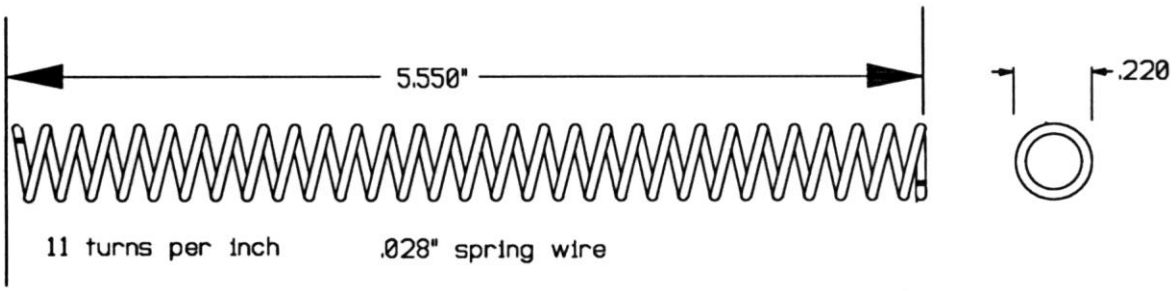


Figure 6-5: Dimensions of recoil spring that will operate most Savage/Stevens semiautomatic rimfire rifles.

Action fails to close: The most probable causes of this malfunction in ·22-caliber semiautomatic rifles lie in the breechblock, the bullet incline in cartridge guide, or a fouled magazine tube. The solution to all of these is simple — clean and degrease all affected parts. Also polish the bullet incline and oil it to prevent rust.

When an action fails to close and a thorough cleaning does not solve the problem, look for a cartridge-guide spring that is out of adjustment. If found defective, adjust or fit a new one. Adjusting cartridge-guide springs can be tricky, so try to use a new one if at all possible. Here are some other items to check when an action fails to close:

- Check for rub marks in the stock caused by the moving parts of the action.
- Check for alignment of operating slide guide to receiver.
- Check the end coil of mainspring.
- Check for bolt interfering on the feed lips of the magazine.
- Check the extractor to be sure it isn't binding.
- Check the face or hook of the extractor for burrs.
- Check the extractor cut in the barrel to be sure the extractor lines up and isn't hitting the edges of the cut due to a slight rotation of barrel.

If any of the above faults are found, replace any worn or broken parts; hone and polish any surfaces that contain burrs or rough edges.

Loose barrel or stock: Check for a loose barrel adjusting ring or for a broken barrel-locating pin. Adjust the ring or replace the pin. Check the inletting and bedding of the barrel to stock; the pressure point should be at forend tip only.

Loose stocks may be caused by the stock-bolt nut being loose in some rifles or by bolt holes enlarged due to wear. Cracks in the wood can also loosen the stock, as well as loose tang screws (where applicable).

TROUBLESHOOTING CHART
·22 Caliber Rimfire Semiautomatic Rifles

Malfunction	**Probable cause**	**Corrective action**
Fails to lock	Faulty engagement of carrier to carrier dog	Hone until fitted properly
	Worn carrier	Replace
	Worn carrier dog	Replace
	Weak or broken carrier spring	Replace
Carrier fails to lift cartridges	Weak or broken carrier dog spring	Replace
	Carrier dog broken	Replace
Fails to extract	Extractor claw dull or weak	Sharpen claw or replace
	Extractor clearance cut in barrel too deep	Replace barrel
	Edge of chamber has heavy burr	Ream out burr
Fails to eject	Extractor has too much space between claw and face of breechblock	Bend lug to shorten space at claw
	Improperly fitted firing pin	Replace
Fails to feed	Rust, dirt, or dents in magazine tube	Clean and repair
	Faulty cartridge stop	Reduce bevel at lower front end

Figure 6-6: Troubleshooting chart for rimfire semiautomatic rifles.

Chapter 7 - Centerfire Single-Shot Rifles

Much of the work performed by gunsmiths involves the repair and maintenance of centerfire rifles. To keep these firearms in good shooting condition, the gunsmith must have a thorough knowledge of what is commonly known as troubleshooting, the ability to determine the cause of any gun problem and correct it without wasting time or using unnecessary new parts.

Troubleshooting centerfire rifles covers a wide range of problems, from replacing an ejector spring to diagnosing why a rifle is not shooting accurately. In any case, troubleshooting usually requires a good knowledge of basic firearm design and the use of tools, and a systematic and methodical approach to the problem.

Those involved in the maintenance and repair of firearms, either at home or in the gunshop, should remember that every gun problem can be solved — regardless of its nature. This chapter is designed to help you solve the more common problems that occur with centerfire rifles.

Single-Shot Rifles

Single-shot, centerfire rifles vary widely in design and quality, the simplest designs malfunctioning least. Single-shot actions have been made in regular falling-block (Fig. 7-1), rolling-block, and drop-block versions (Fig. 7-2). Among the best of the single-shot actions are the famous Winchester high and low sidewall and the relatively new Ruger Model 1, which is based on the excellent falling-block action and is quite complex in design.

Falling block design: This type of single-shot action was designed so that the breechblock travels vertically in a mortise in the receiver. It is exceptionally strong and provides a perfect gas seal.

The direct ancestor of most modern single-shot rifles was the Sharps rifle, employing a falling block design. The original Sharps had an exposed hammer, but a number of hammerless variations followed including the Ballards and Farquharsons, while the Winchester Model 1885 single-shot rifle retained the exposed hammer. This latter model, designed by John M. Browning, is known in its many versions as high wall, low wall, thick wall and thin wall, which refer to the receiver dimensions.

In general, falling-block actions operate by a pivoting trigger guard (or lever behind the guard) which drops the breechblock when the lever is moved forward, exposing the chamber for loading. The lever is then pulled back to close the block for firing. After firing, extraction (and ejection in some cases) is accomplished by opening and/or snapping the lever shut.

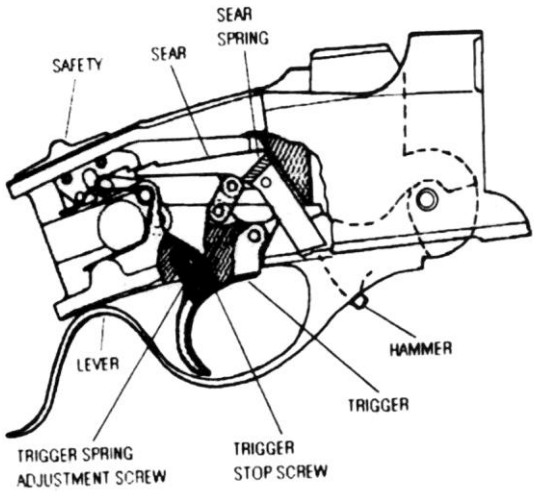


Figure 7-1: The Ruger Model 1 is a modern example of the centerfire single-shot action.

Rolling-block design: The rolling-block system is the simplest of all single-shot designs and consists basically of two pivoting breech-locking mechanisms, one mounted directly behind the other, attached to the frame by large axis pins.

The primary mechanism is the breechblock, which also contains the firing pin. It can be rolled up and down from the chamber (when the hammer is cocked) by means of a thumb spur or extension. When flush against the chamber, the breechblock is spring supported but not locked into place. The locking occurs a split second before the hammer hits the firing pin by means of a projection under the surface of the hammer assembly which slides into place behind and under the breechblock.

The Remington rolling block was used for military purposes by several countries in calibers as 7 x 57 mm, ·45-70, ·43 Egyptian, and several others.



Figure 7-2: Winchester Model 1885 single-shot action. This rifle opened a working relationship between John M. Browning and Winchester that lasted for over 20 years. Practically every firearm manufactured by Winchester during this period was a Browning design.

Tipping-block system: The tipping-block system is used in the famous Martini-Henry action and employs a block hinged at the rear which, when activated by a lever, lowers the front edge and exposes the chamber (Fig. 7-3). A lever arrangement in the Martini action also cocks a concealed hammer when the action is opened.

In modern hammerless single-shot actions, the gun is usually cocked as the striker mechanism is pushed back against the spring tension of the mainspring until the striker is caught and held by the sear. This motion also unlocks and drops the breechblock, exposing the chamber for feeding and loading. When the lever is brought back up, the block rises behind the cartridge, locks the action, and is ready for firing. Once fired, the downward and forward motion of the lever lowers the breechblock, extracts and ejects the fired cartridge case from the gun, and the rifle is again ready for reloading by hand.

Hammer models work essentially in the same manner except that the hammer must be cocked manually after the cartridge is chambered and the action is locked. Actually, the hammer is usually cocked before the action is opened, and then the hammer is lowered to half-cock until the gun is ready for firing.

The many single-shot rifles manufactured by the Stevens Arms Company utilize a variety of designs, but all of them are based on the actions described here to some extent.

Common Malfunctions

Unlike ·22-caliber rimfire single-shot rifles (of the bolt-action design), single-shot centerfire rifles are sometimes very complex in design, often more than their repeating counterparts. Of the half dozen or so models currently in production, the Browning ’78, Hyper-Single Rifle, Ruger No. 1, and the Wickliffe all use the falling-block design. The Riedl single-shot rifle utilizes a rack-and-pinion action, while Harrington & Richardson uses the break-open action almost exactly like its single-barrel (single-shot) shotguns. There are also replicas of rolling blocks and Springfield rifles currently available.

Since Harrington & Richardson uses the break-open single-shot shotgun design in their single-shot rifles, the same troubleshooting methods as described under single-shot shotguns in later chapters may be used. The remaining models, however, are unique.

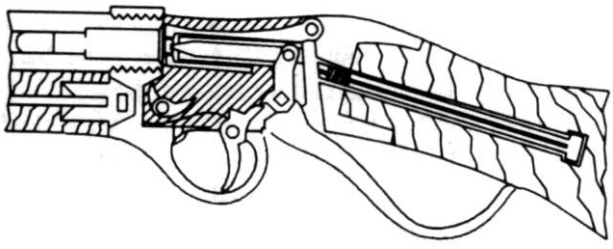


Figure 7-3: The tipping-block system employs a block hinged at the rear which, when activated, lowers the front edge and exposes the chamber.

Ruger Single Shots

The Ruger No. 1 single-shot rifle and the Ruger No. 3 single-shot carbine have essentially the same type action except that the carbine has a different lever. Loading and ejection on both models are accomplished by lowering the lever (which opens the breech) and inserting a cartridge fully into the chamber. The lever is then raised until the lever latch engages; this action closes and locks the breech. The operation of the lever opens and closes the breech, automatically ejects the fired cartridge, and cocks the hammer, which is concealed within the mechanism. On this model, the breech is fully in position and locked before the lever latch engages, but firing the rifle with the lever latch unengaged is not recommended.

The safety on the Ruger Models 1 and 3 can be engaged only when the hammer is cocked. These rifles can be loaded and unloaded while the safety is on. The mechanism not only blocks movement of the sear but also retracts the hammer.

When the hammer is cocked, it protrudes slightly from the lever, serving as a cocking indicator that can be felt and seen.

When engaging the safety (by sliding it to the rear), be sure that it is moved all the way to its extreme rear position. There is an extra resistance to the safety movement about halfway back, and some may confuse this resistance with the true safety position. The word "safety" should be clearly visible when the safety is on.

The trigger sear is preset at the factory to provide a recommended minimum sear engagement with the hammer. The safety is fitted after the sear is adjusted. Accordingly, the sear should not be altered by untrained persons, as this is a job only for professionals. The minimum weight of pull is established by the sear spring and this spring should not be modified. On the other hand, the weight of pull can be increased beyond this minimum by tightening the adjustment screw on the trigger mechanism.

In the event that snap-action automatic ejection is not desired, the ejector spring can be removed by taking the forearm and backing off on the ejector strut adjustment screw. The ejector will then function as an extractor only, and the cartridge will be partially removed from the chamber by the final downward motion of the lever. Should the snap-action mechanism be replaced at a later date, do not over-tighten the adjustment screw because this will bind the action. The force of ejection can be altered to some extent by the adjustment screw.

To disassemble the Ruger Model 1, first make sure the gun is unloaded and then remove the forearm. With the hammer cocked, insert a slave pin through the hole in the hammer strut and pull the trigger to release the spring tension. Remove the spring and strut as an assembly. Lower the lever and remove the lever-pivot screw and the lever-pivot pin. Remove the hammer. Raise the lever to close the breech before lowering the lever about halfway and then pull downward on the lever, removing the breechblock, breechblock arm, and the linkage as a unit. Remove the ejector, ejector plunger, and spring in the receiver.

To reassemble, insert the ejector, ejector plunger, and spring in the receiver. Assemble the breechblock, breechblock arm, ejector roller, and linkage (Fig. 7-4) and replace them as a unit in the receiver while holding the ejector against the inside receiver wall. Position the hammer in the lever and engage the lever and link (Fig. 7-5). Now hold the ejector against the inside receiver wall and insert the lever into the receiver opening. Move the lever to its closed position while depressing the trigger. Replace the pivot pin and retaining screw before continuing.

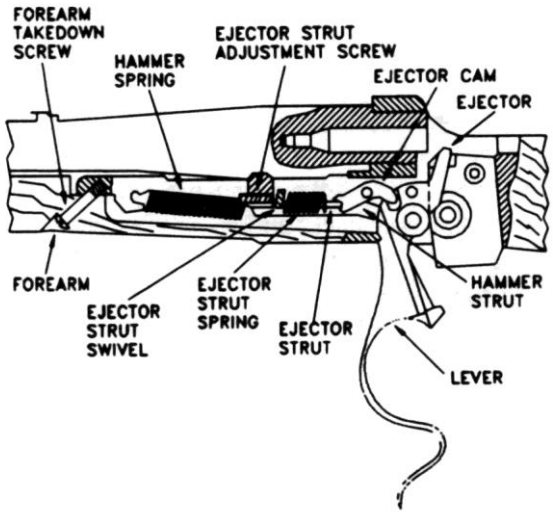


Figure 7-4: Assembly procedure for the breechblock, breechblock arm, ejector roller, and linkage of the Ruger Model 1.

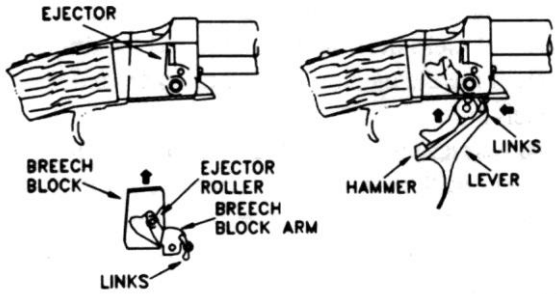


Figure 7-5: Positioning the hammer in the lever and engaging the lever and link of the Ruger Model 1.

Replace the hammer spring and strut assembly before cocking the hammer and removing the slave pin installed earlier. Finish by reassembling the forearm.

The Ruger No. 1 rifle is an exceptionally well-built gun with many hand-fitted parts. If the owner of such a rifle does his part, such a gun will last several lifetimes without a single malfunction. The following maintenance is recommended by the manufacturer:

The mechanism should be lubricated with light gun oil, but not too heavily. As a rust-prevention measure, all surfaces, including the bore of the barrel, should be wiped with oil after use. But again, do not flood the bore with oil.

A comprehensive field cleaning of the mechanism is not required more than once a season unless obviously necessary. The purpose of such cleaning is only to remove powder residue from internal components and as a rust prevention procedure in the event that the gun has been soaked or submerged in water. The barrel should always be cleaned after each use.

If sand or other foreign matter in any appreciable quantity enter the mechanism, the reliability of functioning will probably be impaired until the gun is dismantled and thoroughly cleaned.

Malfunctions in the Ruger Model 1 can usually be traced to dirty and gummed-up action, worn or broken parts, or parts assembled wrong. Unless the problem is obvious, the rifle should be disassembled as described previously and thoroughly cleaned and degreased. Inspect every part for wear, breakage, burrs, etc. Note your findings. The exploded view in Fig. 7-6 should serve as a guide to ascertain that the rifle is assembled correctly. Broken parts should be obvious and worn parts can be detected by rounded edges and bright spots where mating surfaces were rubbing. Replace or rebuild any broken or cracked parts, assemble, and test fire. Remove any burrs and polish the surface smooth.

Remington Rolling Block

The Remington rolling block action has been around for a long time and is chambered for a long list of cartridges. The rifles were used mainly by foreign governments desiring an inexpensive, serviceable, simple military weapon. Many of these actions have found their way back to this country, some 50 to 100 years later, and have been distributed by arms dealers.

The Remington rolling block is a relatively simple action with the main points of wear being the springs, including the lever spring, the trigger spring, and the mainspring. If the parts are not worn and are assembled correctly, only one part gives serious trouble: the firing pin. Most rifles of this type are stored with the hammer down, holding the firing pin in its forward position. If left to remain in this position for extended periods of time, especially in humid weather, the firing pin is likely to rust tight in this position. When such a frozen firing pin is slammed shut on a live round, chances are it will set the cartridge off. Due to the design of the action, there is nothing but your thumb to hold the block closed. A few years back, one shooter discovered this when his rolling block chambered for the 7mm Mauser discharged upon closing the block. This sheared off part of the breechblock and seriously injured his right hand.

Protruding firing pins have also caused trouble in other types of rifles, firing prematurely (firing before the action is locked) and causing semiautomatic guns to fire fully automatic!

The Model 1902 rolling-block action is the largest and strongest of the rolling-block lines, but the 7 x 57mm Mauser is still about the hottest cartridge that one would want to put through it The 1½ action (1888-1897) will handle some of the low-powered centerfire cartridges like the ·22 Hornet and ·25-20 if the action is tight and the firing pin is bushed.

Some of the worn actions can be given a face-lift and put back into service by using one or more of the following suggestions.

Bush the firing pin: On all rolling blocks made before 1902, the firing pin hole should be bushed and the big firing-pin tip replaced with a smaller one.

Refacing breechblocks: If breechblocks are slightly pitted, they can be carefully filed down with a wide mill file. However, if the pits are deep around the firing pin hole, a large bushing should be fitted rather than trying to file down the face and taking a chance on not getting it square.

Adjusting trigger pull: The heavy trigger pull on most rolling block actions can be remedied somewhat by honing the sear notch in the hammer and the sear tip of the trigger, but first lighten the hammer and reduce the tension on the mainspring. Usually a lighter trigger pull will result without further ado. If honing is still necessary, it should be done with extreme caution.

The hammer can be made considerably lighter by thinning the spur and drilling a hole or holes in the body. The surplus metal can be ground away, the surface polished, and the spur checkering recut with a metal checkering file. The holes will be covered if drilled in the rear part of the action only.

You can reduce the tension of the mainspring by loosening the mainspring screw a turn or two, testing after every half turn or so. However, if the mainspring is ground or filed a bit thinner, the hammer will be smoother and easier to cock.

If you still feel that the trigger pull is too heavy, hone the sear notch with a fine knife-edged Arkansas stone, using plenty of honing oil. Try the pull frequently and never have less than 3½ pounds of pull on this type of action: four pounds is better. Test with a trigger-pull gauge.

Troubleshooting the remaining single-shot actions is a matter of understanding how the action operates first, and then inspecting the gun to see what is not functioning correctly. Before the initial inspection, however, make certain that the gun is thoroughly cleaned and degreased. Then inspect each part individually. Older guns should be given an especially close examination to detect any hairline cracks in the parts. See the troubleshooting chart below.

TROUBLESHOOTING CHART
Centerfire Single-Shot Rifles

Malfunction	Probable Cause	Corrective Action
Poor accuracy	Loose sights	Tighten
	Worn rifling	Lap barrel; install new barrel; rebore or reline
	Rough trigger mechanism	Hone contact points to smooth
Rifle fires when block is closed	Protruding firing pin	Shorten, round, and re-harden firing pin
Hard trigger pull	Heavy mainspring	Grind mainspring to lighten
	Rough sear notch in hammer and/or sear tip of trigger	Hone to smooth
Misfires	Firing pin worn or broken	Replace
	Weak mainspring	Replace
	Dirty and gummed-up mechanism	Clean thoroughly

Figure 7-7: Troubleshooting chart for centerfire single-shot rifles.

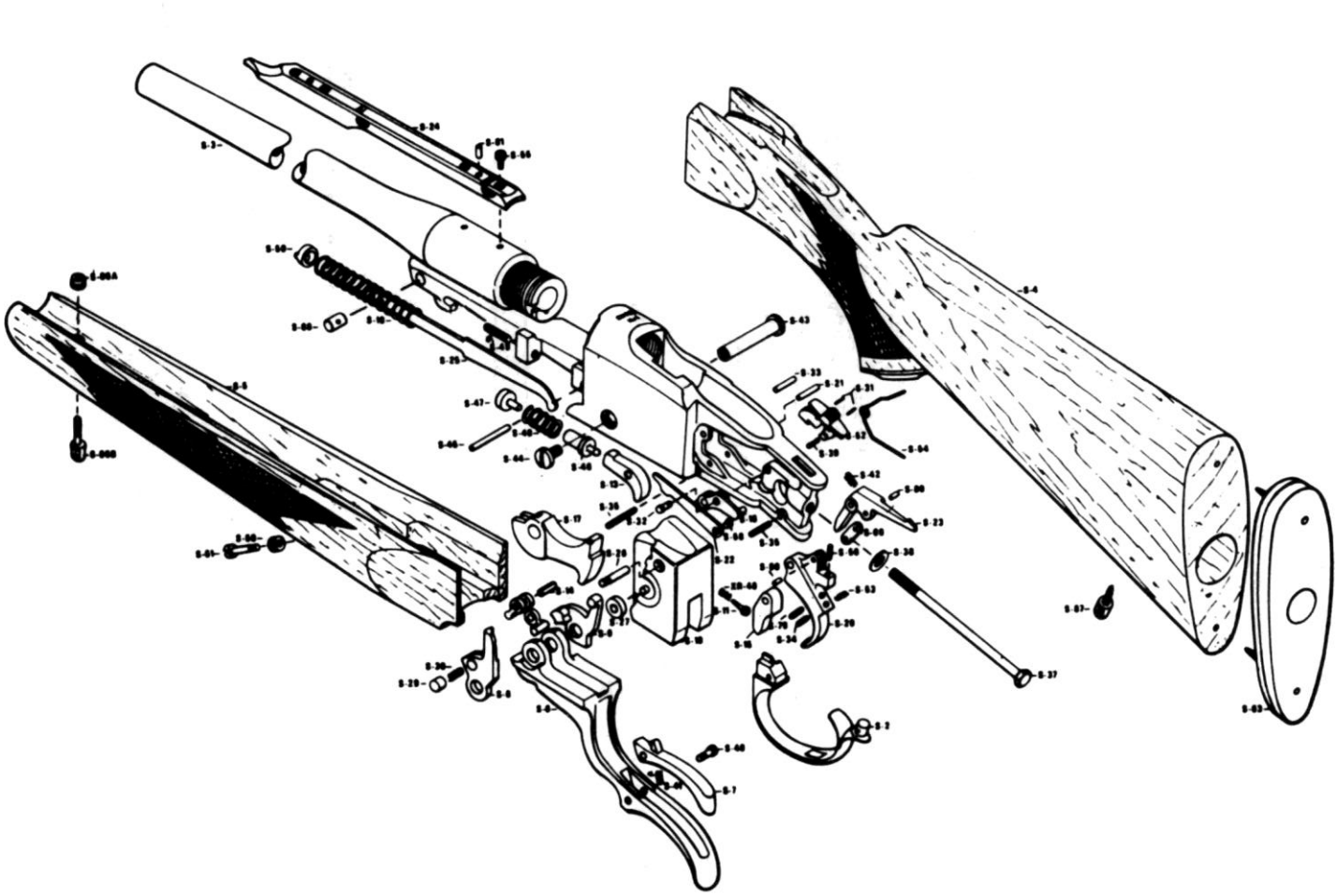


Figure 7-6: Exploded view of Ruger No. 1 single-shot rifle. Such views are extremely useful to the gunsmith to see the relation of the various parts to each other.

Chapter 8 - Centerfire Bolt-Action Rifles

Bolt-action rifles seldom give trouble even if misused, but occasionally a problem will develop that requires the attention of an expert Some of the more common problems include poor accuracy, the breech-bolt binds, the cartridge won't feed into the chamber, the breechbolt pulls out of the receiver or overrides the cartridges in magazine, the firing pin follows down, it misfires, a defective safety, the magazine cover fails to open, it fails to extract, and it fails to eject. These categories cover just about every malfunction possible in the conventional bolt-action rifle.

Operating characteristics: Bolt-action rifles have a turnbolt with a knobbed handle. The bolt slides in races machined in the receiver. When ready for firing, the bolt is in its forward position — handle down, locking the action, and supporting the cartridge head. The locking arrangement in high-powered rifles is accomplished by two or more lugs on the front end of the bolt rotating into slots at the front of the receiver.

After firing, when the bolt handle is lifted, the upward motion frees the fired case from the chamber wall by the reverse rotation of the bolt handle, and cocks the action. The backward pull extracts and ejects the fired cartridge case. The bolt in its rearward motion uncovers the magazine, allowing the spring-loaded magazine follower to push up a fresh cartridge high enough for the bolt to engage it on the forward stroke and push the fresh cartridge into the chamber.

The operation is completed when the bolt turns down, engaging the hook of the extractor in the extractor groove circling the base of the cartridge and camming the locking lugs home, thus fully locking the bolt and bringing the hand on the bolt knob near the trigger, ready to fire. The firing pin of bolt-action rifles is actuated by the compression of a heavy spiral spring. On most other types of actions, the firing pin is actuated by a blow from a hammer. The safety on a bolt action prevents movement of the firing pin. On some rim fire rifles the opening or closing of the bolt sets an automatic safety which must be released before firing. Bolt actions, and for that matter all types of actions have built-in safety devices that prevent firing unless the action is fully locked. Thus, the Model 70 may be loaded or unloaded by manipulating the bolt with the firing pin locked.

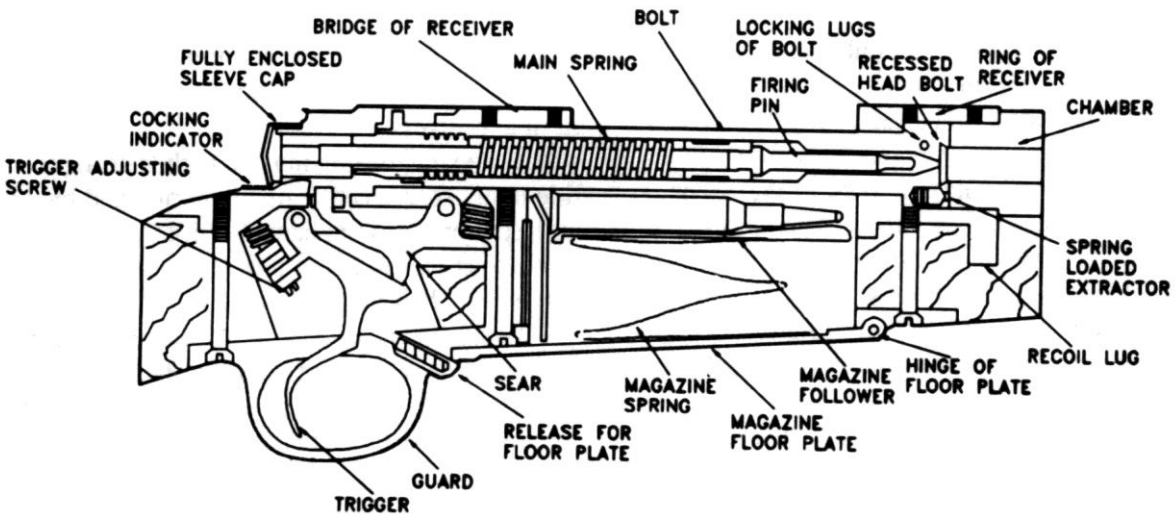


Figure 8-1: A cross-sectional view of a Winchester Model 70 bolt-action rifle.

Bolt-Action Maladies

Poor accuracy: The bolt-action rifle has the reputation of being the most accurate rifle ever made, so when one does not group as it should, you know that something is wrong. If the rifle is old or shows signs of hard use, you can assume that the rifling is shot out or pitted so badly that accuracy has been affected. Of course, the only way to be sure is to check the rifling carefully with a bore light.

At the first sign of poor accuracy, the stock should be the first area to check over thoroughly. If the stock is warped and the barrel does not line up properly in the barrel channel, coat the bottom of the barrel with Prussian blue — applied in a thin, even coat — and insert the barrel into the barrel channel of the stock. Any high spots or interference in the barrel channel will be clearly marked so that they can be scraped away. Of course, if the stock is too badly warped, it should be replaced.

In most cases, the barrel of bolt-action rifles should bear on the bottom of the barrel channel in the stock only at the fore-end tip. This bearing point can be from a point contact up to about W. Glazed spots in the channel indicate barrel contact with the wood. Again, Prussian blue coated on the barrel should show these spots readily. Any such interference points found should be scraped away using conventional inletting tools. Note particularly the area around the point where the barrel joins the receiver.

If these checks turn up okay and the accuracy still isn't up to what it should be, continue checking the rifle to see if any of the screws holding the stock to the action are loose. Then inspect the crowning on the muzzle for eccentricity of crowning to bore, and for any upsetting of the rifling at the muzzle. If the latter problem is discovered, place the barrel in a lathe and turn back the barrel and recrown.

Metal fouling is not too common in the larger centerfire calibers, but just the opposite is true for the small-caliber, ultra-high velocity cartridges. When metal fouling does occur, accuracy is badly affected. A metal fouling solution that has been around for a long time consists of the following drug-store items:

- 1 oz. ammonium persulphate
- 200 gr. ammonium carbonate
- 6 oz. stronger ammonia
- 4 oz. water

Mix these ingredients in a large glass bottle and let stand. Then plug the chamber end of the barrel with a rubber plug or cork. Secure the barrel and action in a position so that the muzzle is pointed upward. Carefully pour the solution into the barrel until it is full, but be careful not to get any of the solution on the outside of the barrel as it might injure the bluing. If the solution is allowed to remain in the bore about thirty minutes, all metal fouling should be removed. Then pour all of the solution out and rinse the barrel thoroughly with hot water, the hotter the better. The barrel should dry almost instantly due to the heat generated by the hot water. When dry, lightly oil the bore to protect it from rust.

After removing the metal fouling, bore sight the rifle and check accuracy with ammunition from different lots.

Breechbolt binds: A tight bolt can indicate burrs on the action mating surfaces, or the bolt may be fitted too tightly in the receiver. A small amount of filing, followed up with honing and polishing with crocus cloth, will relieve tightness where interference is confined to one or two small areas but not enough to loosen a snug fit in a receiver.

The extractor ring may be high, causing the bolt to ride tight. To correct, remove the ring and remove any high spot on the ring channel. Refit the ring and try for smoothness. If this doesn't solve the problem, a new ring will have to be fitted.

Failure to feed: The most probable cause of this malfunction is a tight extractor. In altering the extractor, extreme care should be used and any adjustments made should be done on a trial and error basis; that is, take only one or two file strokes at a time, then try the extractor for fit With some experience, you'll be able to look at the degrees of tightness and then know almost exactly how much metal to remove. Too much filing may cause further malfunctions.

If the extractor is correctly fitted, check the magazine-follower spring, as it may be too weak. To correct, remove the spring and open it up slightly (stretch it) but carefully avoid overspreading and injury to the spring. Again, use the trial — and — error method until it functions properly.

The follower could be binding in the magazine due to the spring leaves canting sideways. This will cause the follower to bind on the inner wall of the magazine. Straighten it with care and watch for this point when opening up the spring.



Figure 8-3: When feeding problems develop in bolt-action rifles, always check the magazine-follower spring.

Breechbolt pulls out of receiver: The bolt stop is not functioning properly when this malfunction occurs. Check to be sure it is free in the slot in the receiver and that the trigger pin, on which the stop pivots on some bolt-action rifles, is not loose in the receiver. Make sure the spring functions freely in its seat and does not bind or is too weak. If necessary, replace either or both spring and stop.

Breechbolt overrides cartridges in magazine: A weak follower spring is probably the culprit but can be remedied by removing the spring and spreading the three angles slightly to increase the tension on the follower. This should be done on a trial — and — error basis as explained before. Make sure the spring is not twisted, causing the follower to bind on the side of the magazine.

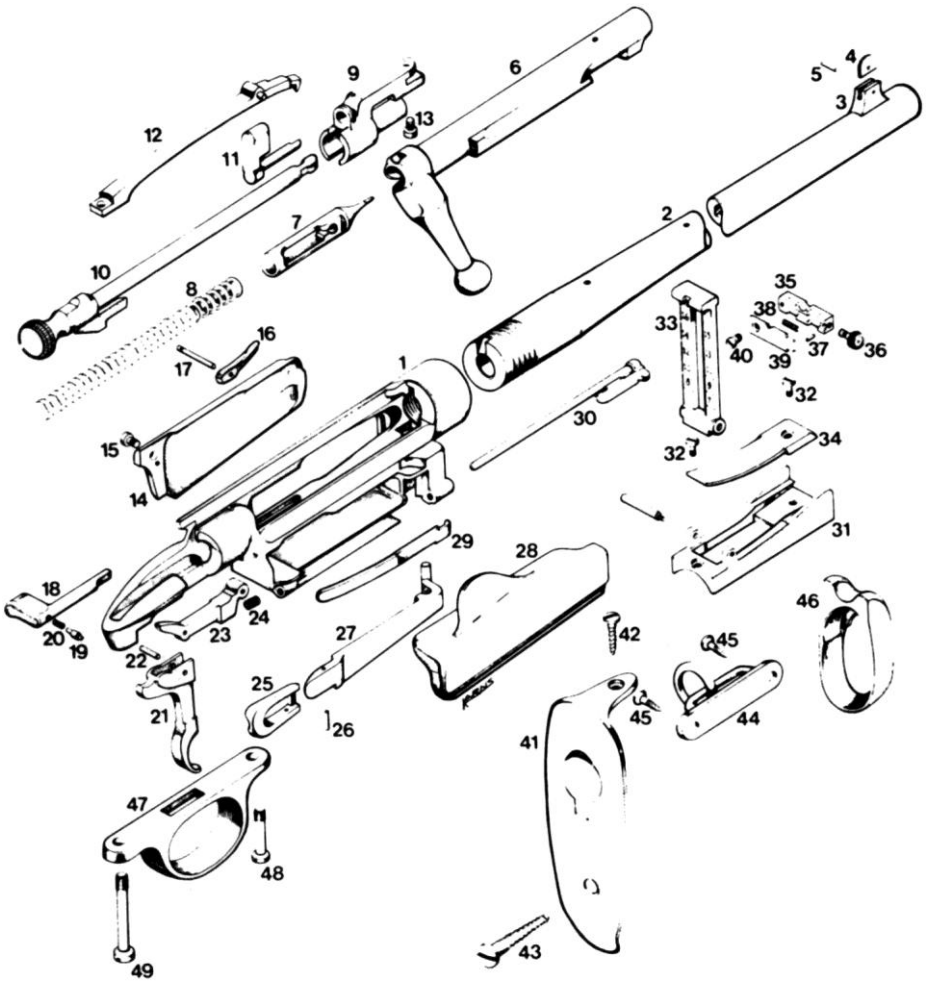


Figure 8-2: The ·30-40 Krag was the first bolt-action rifle adopted by the U.S. Government. The Springfield Model 1903 followed in the early 1900s and remained the service rifle of the U. S. armed forces for nearly 40 years.

Parts List					
Key No.	Part Name				
1	Frame	19	Cut-off Plunger	36	Sight-Slide Adjustment Screw
2	Barrel	20	Cut-off Plunger Spring		
3	Front-Sight Base	21	Trigger	37	Adjustment-Screw Pin
4	Front-Sight Blade	22	Trigger Pin	38	Slide-Tension Spring
5	Front-Sight Blade Pin	23	Scar	39	Sight-Cover Plate
6	Bolt Body	24	Sear Spring	40	Sight-Cover Plate Screw
7	Striker	25	Follower	41	Buttplate
8	Mainspring	26	Follower Pin	42	Buttplate Screw (upper)
9	Bolt Sleeve	27	Carrier	43	Buttplate Screw (lower)
10	Cocking Piece	28	Magazine Gate	44	Saddle-Ring Rail
11	Safety	29	Magazine Spring	45	Saddle-Ring Rail Screws (2)
12	Extractor	30	Magazine-Gate Hinge Pin and Lock		
13	Extractor Rivet			46	Front-Stock Band
14	Sideplate Cover	31	Rear-Sight Base	47	Trigger Guard
IS	Sideplate Screw	32	Rear-Sight Base Screws (2)	48	Trigger-Guard Screw. Front
16	Ejector	33	Elevation Bar		
17	Ejector Pin	34	Elevation-Bar Spring	49	Trigger-Guard Screw. Rear
18	Magazine Cutoff	35	Sight-Slide Adjustment		

Firing pin follows down: This problem is caused by an overadjustment on the trigger adjusting nuts or no follow-through on the trigger. Readjust the trigger according to the type of trigger mechanism installed in the rifle. Make sure the trigger has follow-through after the adjustments are made.

Another possible cause is the sear may not be engaging the firing pin enough to retain it. Make sure the sear and sear spring are not binding in the receiver.

Headspace problems: Insufficient headspace is seldom encountered in modern American firearms but is found on some of the older military weapons. Many bolt-action rifles were used for military purposes in foreign countries. These were imported to the United States, distributed through gun dealers, and have since fallen into the hands of many shooters. The majority of these guns were checked by the distributor, and the bad ones were rejected and dismantled for parts. The better ones were sold for shooting. However, some of these weapons have dangerously excessive headspace and many of them have let go, to the dismay of the shooter. Therefore, before firing any of the older military weapons, check the headspace. If it is excessive and the gun is a common inexpensive piece, you are better off not using it

If, however, you're working with a basically good and/or desirable firearm, you may wish to set the barrel back to correct the headspace problem. Sometimes, you may be able to correct a headspace problem, especially on the Springfield and Mauser bolt-action rifles, by finding a slightly over-long bolt and substituting this for the original. Otherwise the problem will have to be solved by setting the barrel back.

To set the barrel back, you'll need access to a heavy barrel vise. If you don't have one, don't attempt the job. Once the barrel is removed, it is inserted in a lathe and metal is removed from the shoulder equal to one full turn of the threads. This is to make sure the sights, extractor slots, etc., will line up perfectly as before. This cutting, however, should be done on a trial — and — error basis, being careful not to remove too much metal.

When a barrel is set back, the chamber is usually shortened and must be lengthened to the proper tolerance with a finishing chamber reamer. The reaming operation is sometimes done on a lathe, but more often it is done by hand. Once completed, the action is threaded forward on the barrel until the bolt can be easily closed on the gauge with a slight feeling of resistance.

Excessive headspace, even if not to the point of being dangerous, can affect accuracy considerably. So check the headspace on all guns that complain of poor accuracy.

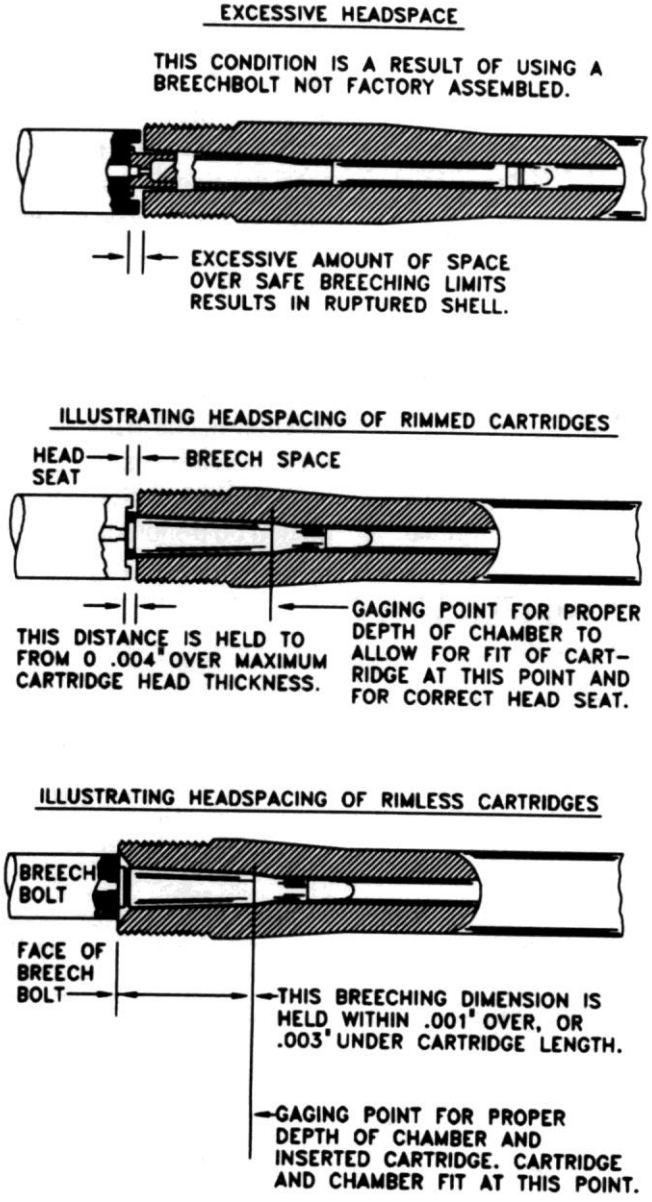


Figure 8-4: Headspacing for rimmed and rimless centerfire cartridges.

Failure to fire: Here is another problem that can be caused by excessive headspace — so excessive that the firing pin cannot reach the primer with sufficient force to puncture it. However, the most probable cause of this malfunction is a short firing pin. Remove the firing pin assembly from the bolt and examine it closely for breaks or a worn firing pin tip. At the same time, check for a broken or weak firing pin spring. Replace all broken or worn parts. Of course, debris in the bolt can cushion the firing pin as it moves forward, restricting the force of the plunger. So always give the bolt assembly a good cleaning and degreasing when it's torn down.

Defective safety: In most cases, this problem can be traced to a worn or altered cam on the firing pin. If the safety binds, try filing the bearing point on the firing pin, taking only a small amount of metal away at a time until the problem is corrected. If the safety is tight in the bolt sleeve, it may be fitted, but usually a new safety is suggested. If a defective safety is found on any firearm, the gun should not be used until the safety is repaired.

Fails to extract: Most centerfire cartridge cases swell when fired, and if the chamber is dirty or pitted, the case will have a tendency to stick. When an extractor hook is somewhat worn, it can slip over the case rim when the bolt is withdrawn, leaving the fired case in the chamber. Sometimes, if the wear is not too bad, the problem may be corrected by honing the extractor hook angle (Fig. 8-5). Do not remove too much metal, as described previously. Proceed on a trial — and — error basis until the extractor functions properly. Also check the extractor ring for tension and adjust it to acquire bite. In rare cases, it may be necessary to replace either or both the extractor ring and extractor.

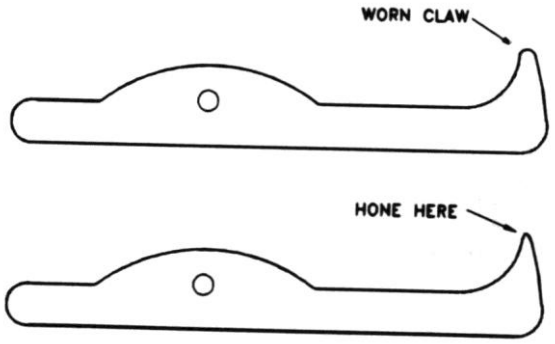


Figure 8-5: Worn or dull extractors may sometimes be corrected by honing the extractor hook angle.

Fails to eject: The ejector is probably not free in its cut in the receiver, the cut may be too narrow or the ejector may be bent. A binding ejector spring may not be functioning properly, or the slot for the ejector in the bolt may not be in line with the ejector. See that the parts are free and functioning property or replace as needed.

See the troubleshooting chart below for more information on troubleshooting bolt-action rifles.

TROUBLESHOOTING CHART
Centerfire Bolt-Action Rifles

Malfunction	**Probable Cause**	**Corrective Action**
Breechbolt binds	Breechbolt may be fitted too tightly in receiver	A small amount of filing will probably relieve tightness where interference is confined to one or two small areas, but not enough to loosen a snug fit in a receiver
	Extractor ring may be high, causing bolt to ride tight	Remove ring and remove any high spots on ring channel. Refit ring. If trouble is not remedied substitute a new extractor ring.
Failure to feed	Extractor too tight	In altering the extractor, extreme care should be used and any adjustments should be made on a trial — and — error basis, filing a small amount of stock at a time. Overadjustment may cause further malfunctions
	Magazine follower spring too weak	Spring may be removed and opened up slightly. This should be done carefully, by trial, to avoid over spreading and injury to the spring
	Follower could be binding in magazine	Spring leaves could be canted sideways, causing follower to bind on inner walls of magazine. Straighten with care and watch for this point when opening up the spring

Figure 8-6: Troubleshooting chart for centerfire bolt-action rifles.

Chapter 9 - Centerfire Lever-Action Rifles

The worst and most common problem that occurs with old Winchester and Marlin lever-action rifles is looseness caused by wear of moving parts. Original round holes in parts have become egg-shaped, mortises in the receiver are worn, and metal has been shed from mating surfaces. Any of these defects can lead to malfunctions, and even making the gun unsafe to fire.

Feeding problems are often encountered that are caused by dented, dirty, or corroded magazine tubes and/or weak magazine springs. Recesses in the receivers of lever-action rifles are prone to collect all sorts of debris and foreign matter which, when combined with gun oil and grease, cake and gum up the action, causing feeding, extraction, and ejection problems.

Another common problem in the older lever-actions is excessive headspace. These rifles locked up at the rear of the sliding breechbolt and, after much firing, stretching occurred which caused excessive headspace.

Worn parts: The easiest solution to worn parts is to replace them — if new parts can be found. Many of the recently produced lever actions, such as the Winchester Model 94 Angle Eject, Savage Model 99s, and the Marlin Models 336 and 1895, are similar to the same models produced nearly 100 years ago, but not quite the same! While some parts are interchangeable, certain modifications to ease manufacturing have taken place, and all parts are not interchangeable.

Replacement parts for the older lever-action guns are becoming more difficult to obtain each year. They are out there, but their cost is a pretty penny. A hammer, for example, for a pre-War Winchester Model 94 rifle or carbine is currently selling for over $50. A pistol-grip lever for a Winchester Model 1886 will run from $60 to $90. A 22-inch carbine barrel for a Winchester Model 1886, in excellent condition, will run as high as $1000.

Many worn or broken parts can be made serviceable by welding, brazing, and honing. For example, worn contact surfaces on trigger sear and hammer notches can sometimes be put back into service by judicious notching with a file, then honing smooth. The surface metal removed will often expose the soft interior metal and the part will have to be rehardened.

Many cracked or broken gun parts can be repaired by silver soldering. Other times the worn surfaces can be built up by welding, filing to shape, polishing, and heat treating.

Oversized holes caused by excessive wear can also be repaired by welding the hole closed. Grind off any irregularities on each side; then drill a new hole. Or, if practical, merely drill a slightly larger diameter hole through the worn one to true it up, and use a larger-diameter pin or screw.

Feeding problems in lever-action rifles can often be cured by giving the action and magazine a thorough cleaning, removing any dents and replacing the magazine spring if weak or broken. Also look for burrs in all areas that the cartridge will contact Remove any burrs with an Arkansas stone, using plenty of honing oil. Coal oil will work fine.

One of the most common problems — dirt — can be remedied easily by giving the entire gun a thorough cleaning — using methods described in Chapter 6. In general, completely disassemble the gun and then submerge all parts in a cleaning solution, such as Brownells' d'SOLVE, mixed with five parts water. Leave the parts in the solution for about 15 minutes before removing them from the tank, drying and finally oiling them. This cleaning will also help you detect worn surfaces that are currently causing problem, or will eventually cause the gun to malfunction.



Figure 9-1: The Winchester Model 94 (1894) lever-action rifle, in its many variations, has been the most popular deer rifle for nearly 100 years.

Winchester Model 94

This is probably the most popular deer rifle ever sold. Sales of the Winchester Model 94 — in its many variations — have passed the 5 million mark! The earlier models have been in the collector status for years, and have risen in value significantly.

The following ailments and cures for the Winchester Model 94 were provided by Winchester Repeating Arms Company, prior to selling out to U. S. Repeating Arms Co.

- *Tight breech*. Try the headspace gauge. If too tight, file or mill the rear face of the bolt to obtain a proper fit, being careful to maintain the existing angles of the bolt face.
- *Cartridges fail to feed back into magazine*. Loose finger lever, positioned at the wrong angle. Tighten finger lever; if worn, replace.
- *Cartridges bind or fail to feed through guides*. Cartridge guides are loose. Tighten the cartridge-guide screws. On pre '64 models, this operation requires an offset screwdriver.
- *Cartridges bind entering chamber*. Check for loose cartridge guides. Tighten if loose.
- *Carrier comes up too soon*. Install a new carrier spring or replace the carrier.
- *Carrier bent or binds*. Install a new carrier. It is not advisable to straighten the carrier.
- *Bolt closes hard on cartridge head*. Relieve the bend or tension of the extractor.
- *Excessive leading*. Pits or nicks in rifling. Lap barrel.

- *Fails to eject — weak ejection*. The ejector binds in the slot in the bolt due to a weak spring. Make sure the ejector is free in the slot; then install a new spring.
- *Fails to extract*—weak ejection. Put a slight bend in the extractor and try for operation.
- *Feeding failure*. Dent or a bend in the magazine tube, the follower sticks, the cartridge stop is upset. Remove dent or install new magazine tube. Replacements are readily available.
- *Stop lug on link low or upset*. Install a new link.
- *Spring cover pushes down hard over cartridge* heads. Adjust the shape of the rib, at the end, on the back of the cover.
- *Spring cover binds on carrier*. Free up the carrier so it functions freely.

Winchester Model 88

The Winchester Model 88 was the firm's first hammerless lever-action rifle. The magazine is of a clip design rather than the older tubular types. This rifle has a reputation for being relatively trouble-free, except when the gun becomes dirty. Then the trouble begins. This foreign matter cakes in the locking lug recesses and prevents the action from closing properly. Bent magazine lips also cause feeding problems that must be straightened or replaced. Other problems and remedies for the Winchester 88 are:

Accuracy. When there is a complaint of poor accuracy with the Model 88, check the stock for proper bedding. If the stock is warped and the barrel does not line up properly in the barrel channel, scrape away the interference point. However, if the stock is warped too badly, a new stock is the best solution.

The barrel should bear on the bottom of the barrel channel in the stock only at the forend. This bearing point can be from a point contact to about ½″. If the channel shows glazed spots which indicate barrel contact with the wood, scrape away these interference points. Note particularly the area around the point where the barrel joins the receiver.



Figure 9-2: The Model 88 was introduced in 1955, offering more modern cartridges (with more power) in a lever-action rifle. The Model 88, however, never came close to gaining the popularity of its predecessor—the Model 94.

Do not remove the line — to — line contact or the slight interference between the magazine-lock housing and the stock. If there is excessive binding when assembling the action to the stock, check the centrality of the magazine-lock housing to the receiver and tap the housing in the direction which will ease the interference.

Continue the accuracy check by examining the forearm screw to see if it is loose. Check for an upsetting of the rifling at the muzzle as well as for excessive headspace. Also check for metal fouling in the bore and alignment of sights for center of impact. Finish the check by testing the rifle with different lots of ammunition.

Action opens after firing. Use a headspace gauge of the proper caliber and check for headspace problems. Also examine fired cases for signs of swelling.

Remove the extractor, plunger, and spring and fire the rifle. Then open the action to see if it opens freely when not extracting a fired case. If the action does open freely, then check the chamber for surface finish, rings, etc. If extreme care is used, the chamber may be polished lightly to remove any small or minor defects on the surface.

With the action closed on a dummy or fired case, pull the trigger to release the hammer. Look inside the magazine well at the hammer contacting the firing pin. Watch the hammer and firing pin while slowly unlocking the guard and slowly rotating the finger lever to see if the hammer is being retracted before the bolthead starts to rotate. If it is, the firing pin will move toward the rear, following the hammer, as it is spring loaded rearward. If the firing pin does not move rearward to follow the hammer, check the firing-pin spring. If the hammer is not cammed backward by the initial stroke of the guard, then the bolt cannot be unlocked. If this condition exists, check the guard at the point it contacts the hammer for signs of battering caused by dry firing of the hammer on the guard when the guard has been disassembled. Place a shim between the guard and the hammer at this point and check to see if the action opens easier. If so, then a new guard assembly is needed.

You should also check the ejector retaining pin to be sure it isn't protruding and binding in the receiver.

Feeding problems. These malfunctions are normally caused by battered or distorted magazines and can be verified by trying several different magazine cases to see if this is the cause of the trouble.

Check to see if the cartridge is being held down in front by the receiver lugs. If so, the sharp comer holding the cartridge may be carefully filed to remove the interference. If the cartridge nose is still held low, the receiver lugs must be modified.

Failure to fire. This condition sometimes occurs in the Winchester Model 88, especially in the original design which had a trigger-stop pin. When the shooter is wearing heavy gloves, the glove may keep the shooter from fully closing the finger lever. This in turn keeps the trigger-stop pin forward, preventing the pulling of the trigger far enough to release the hammer. This problem is corrected by discarding the trigger-stop pin or replacing the hammer catch with a modified hammer catch.

Open the action with the hammer cocked and pull the trigger releasing the hammer. The hammer will fall until it engages the hammer catch. Close the action, and the hammer should be in the cocked position, ready to fire when the trigger is pulled. If the hammer is not in the cocked position, replace the guard latch, the guard-latch spring, the guard-latch spring abutment, the hammer catch, and the hammer lock.

Failure to extract. Use a cartridge case to push the extractor away from the center of the bolt in its dovetail; the extractor should return to its original position freely. Replace the extractor, plunger, and spring if the extractor does not move freely.

Check the face of the barrel for signs of interference between extractor and barrel. If any evidence of interference exists, replace the extractor.

Failure to eject. The ejector should be checked for freedom of motion. If it binds, replace the ejector and spring.

Rough action. If the action opens or cocks hard, check the rear links for smoothness in the cam path; check for interference of guard stud in cam path; and check for interference of the links with the bottom of the radial clearance. Replace the rear links if they are bent.

Check to see that the hammer-catch pin is not protruding and interfering with the links. Also make sure that the lever is being rotated downward without side pressure when it is unlocked.

Inoperative safety. There must be a distinct action of the safety plunger operating in the detents of the safety. If not, then the safety probably has been rotated 180° from its correct position. This can also be checked by looking through the wings of the guard and noting the flat on the safety which should be visible. If the detents appear, rotate the safety 180°.

If the parts are worn, replace the safety plunger and spring with new parts. If new parts are not available, try to locate a "junker" of the same model to salvage the necessary parts.

Troubleshooting techniques for Marlin and others with under-the-barrel tubular magazine are similar to those given for the Winchester Model 94. The Browning BLR and the Savage Model 99 will more closely follow the troubleshooting techniques described for the Winchester Model 88.

The troubleshooting chart below should also prove useful.

TROUBLESHOOTING CHART
Centerfire Lever-Action Rifles

Malfunction	**Probable Cause**	**Corrective Action**
Cartridges fail to feed back into magazine	Loose finger lever at angle	Correct looseness or install new lever
Cartridges bind	Loose screw in cartridge guide	Tighten screws
Fails to extract	Broken or weak extractor	Install new extractor or put slight bend in extractor to strengthen
Carrier binds	Bent carrier	Install new carrier
Fails to feed	Dented magazine tube	Remove dents or replace tube
Fails to eject	Weak ejector spring	Replace spring

Figure 9-3: Troubleshooting chart for centerfire lever-action rifles.

Chapter 10 - Centerfire Slide-Action Rifles

The pump, slide, and trombone action are simply different names for the same type of rifle. This was the fastest-shooting rifle up until the introduction of the semiautomatic. It did not, however, enjoy the same popularity of the bolt- and lever-action rifles.

The slide-action rifle has existed since the late 1800s, but these early models were adapted for use only with relatively low-pressure cartridges, and it was not until Remington introduced the popular Model 14 in 1912 that the pump action became a big-game rifle. The newer Remington Model 760 and its predecessors can handle many of the modern high-powered cartridges, such as the ·30-06, ·270, and ·243 calibers.

Operation

The basic slide-action rifle operates from the movement of a forend slide. As the slide moves rearward, it pushes the bolt assembly back, forcing the hammer downward and ejecting the empty cartridge. Shell ejection is governed by a circular spring in the forward end of the bolt. This spring holds the rim of the cartridge with a special claw-like protuberance inside the spring circle. When the bolt moves rearward, the claw pulls the cartridge out of the chamber. Once the cartridge is clear of the chamber, a spring ejector in the bolt flips the casing out, after which a spring-loaded magazine lifts a new cartridge to the chamber level.

Moving the slide forward moves the bolt forward, chambering the new cartridge. The hammer, which was pushed back when the bolt was back, is held in the cocked position by a special sear that fits into a notch in the hammer. The bolt is locked in place by a turning action which allows special threads on the bolt to engage the threads on a nut and bolt. When the slide is moved as far forward as it will travel, the bolt turns in the locking lugs, locking the bolt in place. Once the locking lugs are engaged, the rifle is ready to fire.

Common Malfunctions

Malfunctions in slide-action rifles are second in frequency only to semiautomatics. The biggest cause of problems with both of these action types is the presence of dirt, dust, and assorted debris that, when combined with gun oil and grease, prevent proper operation. Therefore, at the sign of any malfunction, first strip the gun down to its basic action components and degrease —unless, of course, obvious symptoms dictate otherwise. Other problems found in slide-action rifles are a failure to feed properly, double-feeding, failure to retain cartridges in the magazine, action bars sticking, action failing to lock, failure to extract and eject, failure to fire, failure to cock, gun fires on closing of the action, and safety malfunctions.

Feeding problems: The most common cause of improper feeding is rust or corrosion within the magazine tube. The solution is simple. Merely clean out the tube with a cleaning rod and brush of the proper size saturated with bore cleaner. The job can be hurried by inserting the handle end of the cleaning rod in a drill motor which will rotate the brush rapidly and remove the rust and polish the metal surfaces quickly.

Now check for a weak, rusted, or badly bent magazine spring. Try stretching the spring, then try the rifle for proper feeding. If this works, it's only a temporary solution, and a new spring should be installed.

In box-magazine slide-action rifles — like the Remington Model 760 — check for deformation of the lug on the front end of the magazine box which would prevent holding the magazine firmly in place; that is, into its recess in the front section of the receiver. Also check for deformation of the lug on the rear end of the box to prevent it from locking up securely with the magazine latch.

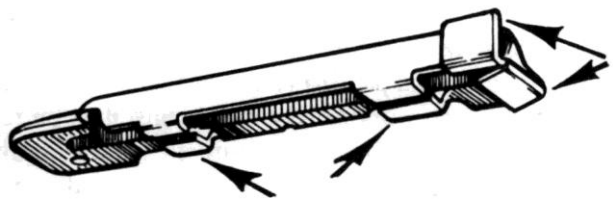
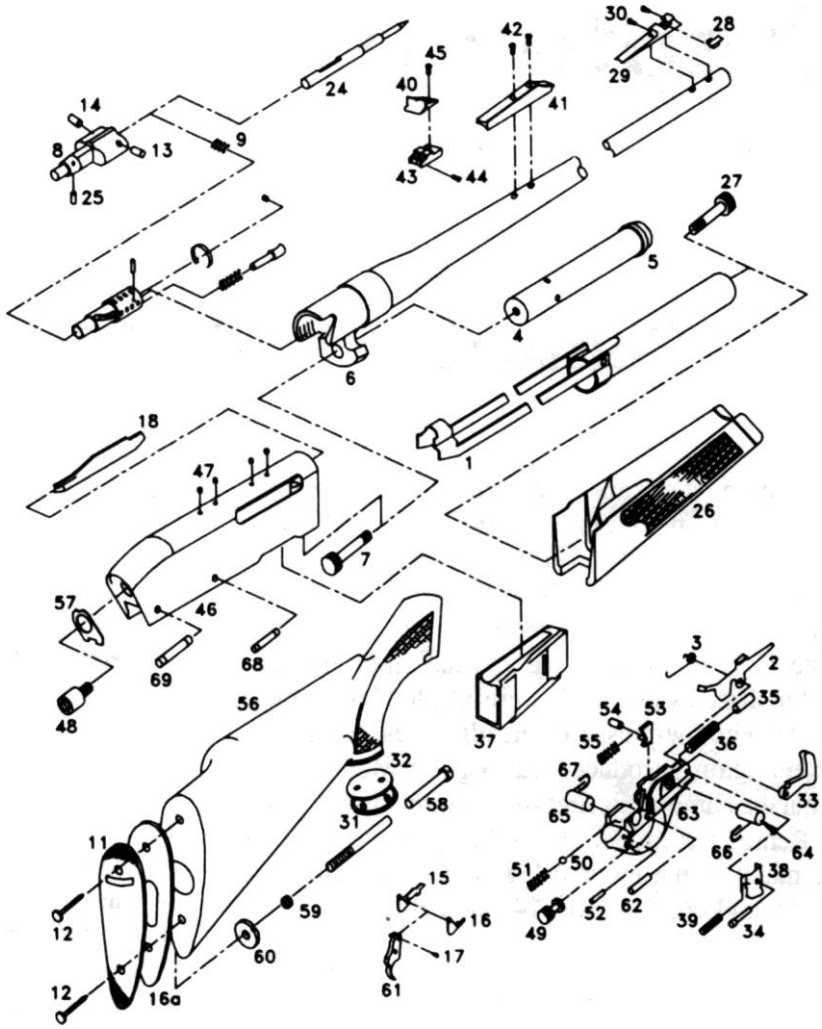


Figure 10-2: When feeding problems develop in the Remington Mode 760 slide-action rifle, check for breakage or deformation of the two rear ears on the top surface and the magazine-spring locating lugs on the under surface.

Check lips on both sides of the top rim of the magazine for deformation. The magazine latch must rotate freely on its spring and be located property on the right end of the hammer pin. It must also engage the notch in the rear of the magazine firmly and locate the magazine securely into its proper operating position. Any deformation or breakage of the locating lug of the magazine latch will hinder its function. Replace if necessary.



Part No.	Part Name
1	Action Bar Assembly
2	Action Bar Lock
3	Action Bar Lock Spring
4	Action Tube Assembly Action Tube Plug
5	Action Tube Ring
6	Barrel
7	Barrel Bracket Bolt
8	Bolt Carrier
9	Bolt Carrier Spring
11	Butt Plate
12	Butt-Plate Screw Butt-Plate Spacer
13	Cam Pm (Ig.) (also used in old style Bolt Carrier)
14	Cam Pin (sm.)
18	Election Port Cover
19	Ejector
20	Elector Retaining Pin
21	Elector Spring
22	Extractor
23	Extractor Rivet
24	Firing Pm
25	Firing-Pin Retaining Pin
26	Fore-end Assembly BDL Grade Fore-end Assembly
27	Fore-end Cap Screw
28	Front Sight Front Sight. Carbine Front Sight. Carbine (low)
29	Front Sight Ramp
30	Front Sight Ramp Screw
31	Grip Cap Grip Cap BDL Grade
32	Grip Cap Spacer
33	Hammer
34	Hammer Pin
35	Hammer Plunger
36	Hammer Spring
37	Magazine Assembly
38	Magazine Latch
39	Magazine Latch Spring
40	Rear Sight Aperture
41	Rear Sight Base
42	Rear Sight Base Screw
43	Rear Sight Slide
44	Elevation Screw
45	Windage Screw Receiver Assembly (Restricted)
46	Receiver Assembly BDL Grade (Restricted)
47	Receiver Plug Screw
48	Receiver Stud
49	Safety Switch
50	Safety Switch Detent Ball
51	Safety Switch Spring
52	Safety Switch Spring Retaining Pin
53	Sear
54	Sear Pin
55	Sear Spring Stock Assembly
56	Stock Assembly. Right Hand, BDL Grade Stock Assembly. Left Hand, BDL Grade
57	Stock Bearing Plate
58	Stock Bolt
59	Stock Bolt Lock Washer
60	Stock Bolt Washer
61	Trigger Assembly (Restricted) [includes parts 15, 16 & 17]
62	Trigger Pin
63	Trigger Plate. R H. Trigger Plate. L H Trigger Plate Assembly. R H Trigger Plate Assembly. L H
64	Trigger Plate Pin Bushing, Front
65	Trigger Plate Pin Bushing, Rear
66	Trigger Plate Pin Detent Spring, Front
67	Trigger Plate Pin Detent Spring, Rear
68	Trigger Plate Pin. Front
69	Trigger Plate Pin. Rear

The movements of the magazine follower must be free to maintain a level pressure against the feeding shells. Check for breakage or deformation of the two rear ears on the top surface (Fig. 10-2) and the magazine spring locating lugs on the under surface.

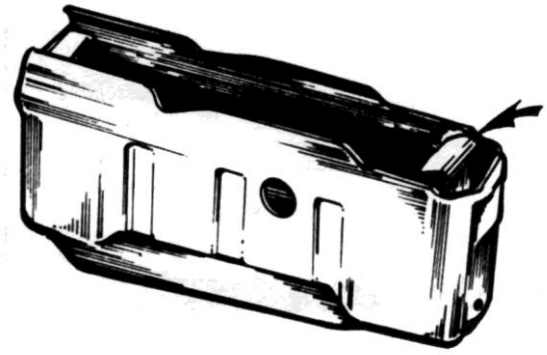


Figure 10-3: The magazine filler piece must be properly assembled to allow free passage of the follower and spring.

Check the magazine spring for free passage in the magazine and to insure that it is securely located to the undersurface of the follower. If the spring is weak or broken, it must be replaced.

The magazine filler piece (Fig. 10-3) must be properly assembled to prevent the free passage of the follower or spring. If this part must be replaced, disassemble from the front end of the magazine.

A defective magazine can also prevent the gun from being loaded. The lips on both sides of the top rim of the magazine must be free of deformation or breakage. They must hold the cartridges securely in a level position. Also the sides and ends of the magazine must be free of deformation, burrs, etc., for free passage of the magazine follower. Deformed lips can sometimes be bent and burrs can be removed by honing, but in most cases it's best to invest a few dollars and replace the magazine.

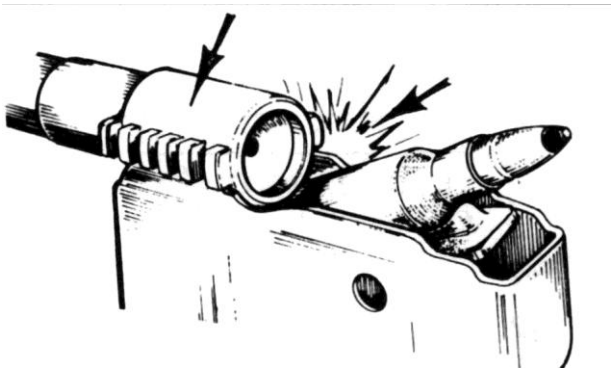


Figure 10-4: There must be no deformation or breakage of the lips on the top rim of the magazine to prevent the free forward-sliding motion of the feeding cartridges.

If the gun fails to load and the above possible causes have been checked, look for breakage or deformation of the magazine follower ears on the rear top face. Also check for deformation or breakage of the locating lugs on the undersurface of the follower.

Gun fails to lock: In box magazine slide-action rifles the magazine latch may be locating the magazine too high, causing the action to bind. There must be no deformation or breakage of the lips on the top rim of the magazine to prevent the free, forward-sliding motion of the feeding cartridges. See Fig. 10-4.

Gun fails to open and eject: Check the ejector to insure that it has free movement and is secure on its retaining pin with no breakage or deformation. The extractor must also be free of movement, secure on its rivet or pivot pin, and tight over the rim of the shell. The breechbolt must have free travel and proper heading with no deformation on the face, the lugs, the cam ways, or the shell rim. Both cam pins must be firmly in position. Also check the ejector spring.

A pitted or rusted chamber or deformed extension lugs can hinder the ejector on slide-action rifles, the action bar assembly is another possible source of trouble. The action bars must have free travel with no deformation of the bars of the receiver slots, the bolt carrier must be securely brazed to the action bars and cam pins properly staked, that is, not protruding.

Check to see that the magazine assembly is secure in its proper location and is not hindering the passage of the action bars. It must retain the oncoming cartridges firmly and in a level position.

Slide-action rifles, like all repeating firearms, have a tendency to collect dirt and debris in the action. When this mingles with oil or grease, a variety of malfunctions can occur. Therefore, all components should be thoroughly cleaned and degreased before attempting to diagnose any problems. In addition, slide-action rifles should be completely disassembled at least once a year and given a thorough cleaning, whether the gun is malfunctioning or not.

In disassembling any gun for cleaning or repair, have a good assortment of gunsmith's screwdrivers, drift punches, and a padded vise. Never use the wrong sized driver when working on a gun, as unsightly burred or scratched screw heads are sure to be the result. Always mark screws so they will be returned to the proper holes. Screws may look alike and even be identical, but they should always be returned to the same hole for a proper set

Any surface rust found can usually be removed with fine steel wool (000 or 000 size) without damaging the bluing. First, however, spray the affected area with WD-40 or some similar solvent, let stand for a few minutes, and go to work with the terry cloth towel. If this doesn't work, then use the steel wool very gently — trying to preserve as much of the original finish as possible. See the troubleshooting chart below.

TROUBLESHOOTING CHART
Centerfire Slide-Action Rifles

Malfunction	**Probable Cause**	**Corrective Action**
Cartridges fail to feed in chamber	Carrier does not rise because of binding carrier plunger	Loosen carrier plunger to work freely
	Protruding firing pin	Replace firing pin if broken or firing-pin retractor
	Extractors too tight or binding	Round off bottom edge of extractor
	Bent carrier	Straighten and align carrier
	Carrier binds on action slide	Straighten action slide
Action slide sticks	Bent action slide bar	Straighten or replace action slide
Hammer fails to cock or slips	Foreign matter in sear notch or between trigger and hammer	Clean
	Hammer spring guide rod too straight or assembled improperly	Bend guide rod or reassemble
	Broken or weak trigger spring	Replace
Trigger safety lock sticks	Broken trigger lock plunger spring	Replace spring

Figure 10-5: Troubleshooting chart for centerfire slide-action rifles.

Chapter 11 - Centerfire Semiautomatic Rifles

The fastest operating firearm action available to nonmilitary or law enforcement shooters is the semiautomatic. Although semiautomatic rifles are often referred to as "automatics," this term is a misnomer. The semiautomatic or autoloading rifle requires only that the trigger be pulled for each shot — the remaining functions (feeding, cocking, extracting, and ejecting) are done automatically. For this reason, semiautomatic sporting firearms have become quite popular among hunters who wish to have those quick follow-up shots when needed.

There are three basic groups of semiautomatic designs in use today: gas-operated, recoil-operated, and blowback.

Gas-operated semiautomatic actions. Gas-operated autoloading rifles (Fig. 11-1) have a hole or port in the barrel that leads to a piston chamber. When a cartridge is fired and the bullet passes the hole in the barrel, some of the gases are forced out of the barrel through this hole and into a special chamber (usually located below the barrel), which in turn comes into contact with a piston connected to the breechbolt of the rifles. As this piston is pushed rearward by the gases, it unlocks the breech and pushes the bolt back, ejecting the fired cartridge and recocking the hammer. The breechbolt encounters a recoil spring on its rearward travel which pushes the breech, rod, and piston back to their original positions. On this forward movement, the breechbolt picks up a new cartridge, chambers it, and locks it in place, ready for firing. This operation will continue until the magazine is empty.

The Ml Garand and the Ml carbine of World War II and the Korean conflict are both gas-operated semiautomatic rifles — the Garand using the long-stroke system which has its port about midway down the barrel. The gas entering this port activates a short-stroke piston moving only about ¼″. The short movement of this piston is transmitted to an operating rod or arm which then opens and operates the bolt.

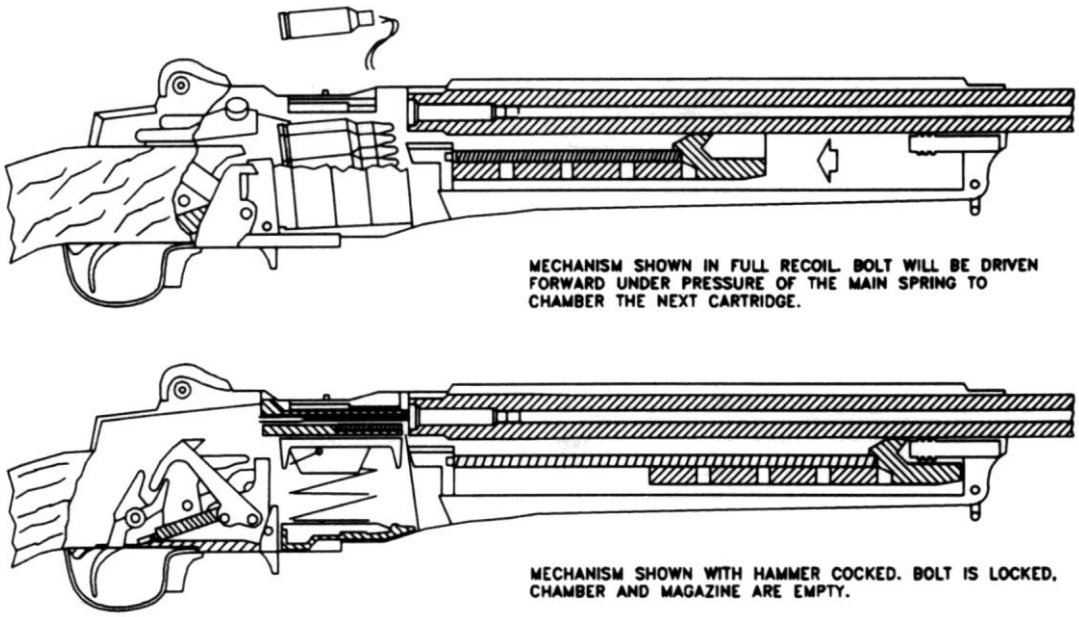


Figure 11-1: Sectional view of Ruger Mini-14 rifle.

Recoil-operated actions. The long- and short-recoil designs have been used for years in shotguns and pistols, but the pressure of centerfire cartridges is too great for this design principle. Therefore, an in-depth explanation of this type of semiautomatic action will be described in chapters under semiautomatic handguns and shotguns.

Blowback design. In this design, the barrel remains stationary while the bolt or breechblock moves to the rear under the driving force from the exploding cartridge. There is no connection or link between the barrel and breechblock, and the timing depends upon the gas pressure, the weight of the breechblock, and the springs designed to hold the breechblock in place against the cartridge.

Rifles that use the blowback design are usually low powered, requiring a relatively short breechblock movement such as the Winchester Model 07 in ·351 caliber and the Thompson submachine gun (Fig. 11-2). The operating functions (feeding, ejecting) are the same with blowback-operated firearms as they are with gas-operated weapons. The comparatively large breechblock required to operate blowback actions makes the system impractical for high-powered rifle cartridges. To illustrate, a ·270 Winchester rifle of blowback design would require a breechblock weighing over 25 pounds!

Semiautomatic rifles are becoming very popular for deer hunting in the eastern United States. Unfortunately, these rifles have more malfunctions than any other type of action, especially when handloads are used.

Besides feeding problems, you'll find autoloaders that fail to extract fired cases; some that won't eject; some that won't fire; and others that won't lock up properly. Following are the most common types of malfunctions, and their remedies, peculiar to semiautomatic centerfire rifles.

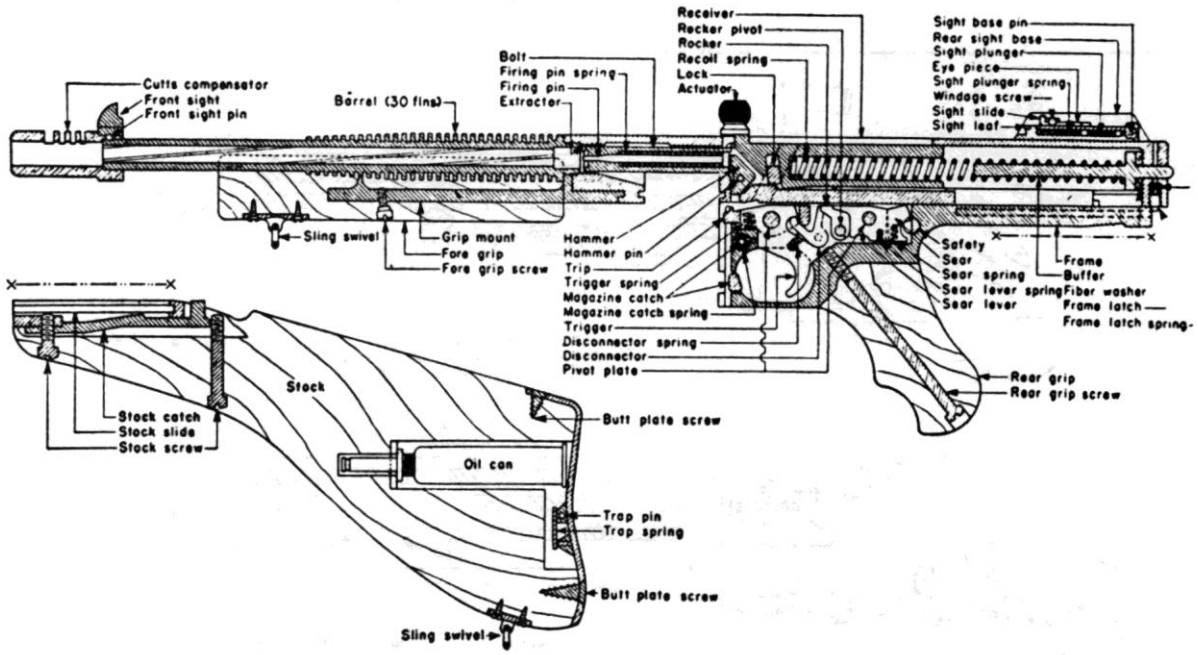


Figure 11-2: The Thompson submachine gun, in both semiautomatic and fully automatic modes, uses the blowback operating system.

Malfunctions

Feeding problems: Quite often, during the occurrence of a feeding problem in autoloading rifles, evidence of the cause may be found by carefully studying the cartridge case itself. Take a look at the brass case at the bullet end of an unfired cartridge. Frequently, a worn or broken part will mark the cartridge in some manner during the gun's failure. Always check for marking on a cartridge case, and try to visualize what caused them.

During the occurrence of a malfunction, damage may also show up on the components. Therefore, inspect the appearance of the components and parts after the action has operated several times. Excessive mutilation of the components may point up the cause of the gun failure.

Semiautomatics with tubular magazines — like the Ruger 44 — are prone to the same feeding problems as other guns with under-the-barrel magazines. Dents, bends, dirt, and rust all prevent the rifle from feeding properly. Weak or bent magazine springs are also quite common. To correct a feeding problem caused by one or more of these faults, clean the magazine tube thoroughly, replace any weak or broken springs, and remove any dents.

Most semiautomatics use a box-type magazine. In these rifles the most probable cause for misfeeding is that the breechbolt overrides the cartridge in the magazine (Fig. 11-3). This malfunction can be because the magazine assembly is too low in the gun; the front magazine lips are bent outward too much; the rear magazine lips are bent downward too much; the magazine sides are bent inward; the breechbolt is chamfered too much at its front face; or the action fails to blow back far enough upon firing.

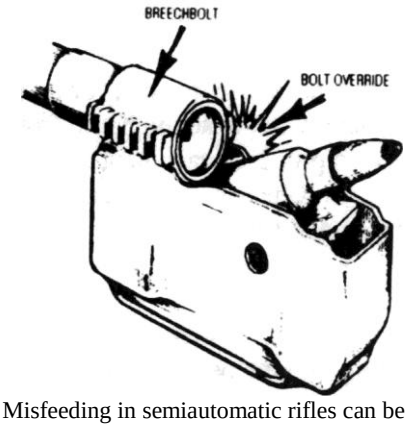


Figure 11-3: Misfeeding in semiautomatic rifles can be caused by the magazine assembly being too low in the rifle.

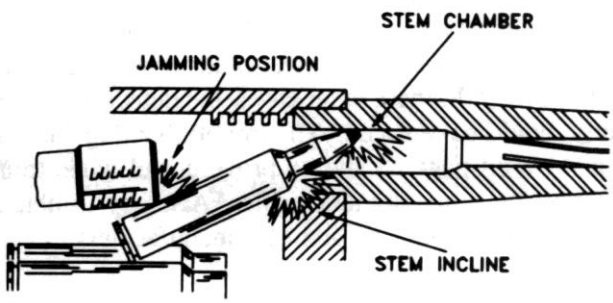


Figure 11-4: When a semiautomatic rifle fails to chamber, the most probable cause is the cartridge stems either the top or the bottom of the chamber.

The lips of the magazine can be bent with needle-nose pliers, but this must be done on a trial — and — error basis. If the magazine is positioned too low, replace it with a higher number size so that it will ride higher, but not so high that it will bind the action. A chamfered breechbolt will have to be replaced. Should the action fail to blow back far enough, it is caused by one of the following reasons:

- Action is binding.
- Gas orifice is defective.
- Gas nozzle or tube is defective.
- Barrel chamber is rough or defective.
- Gas nozzle hole in action sleeve has broken through into spring hole in receiver.
- Failure to replace gas orifice ball and screw.

These problems may be corrected by checking the gas orifice for the proper size according to the manufacturer's specifications. The barrel may have to be replaced. Also check the gas tube opening for damage and adjust or replace the barrel. Replacing worn components may solve the problem; action sleeves and action springs are two parts that sometimes need replacing.

Rifle Fails to Chamber. The most probable cause of this malfunction is that the cartridge stems either the top or bottom of the chamber (Fig. 11-4). If the cartridge stems the top of the chamber, check the barrel extension incline for a proper 45° angle; polish and blend smoothly. If the cartridge stems the bottom of the chamber, check the barrel extension for the proper 45° angle; polish and blend smoothly. You can also replace the magazine or adjust the front fold of the magazine lips to permit a higher angle of feed.

Action Fails to Close: This is usually due to a binding action caused by an ejector port cover out of alignment, an action spring jamming in the action bar sleeve, an ejector or ejector spring binding in the breechbolt, the action bar binding the forend, or a magazine that is out of alignment. The receiver, barrel extension, or bolt carrier could also be out of alignment, or perhaps the breechbolt jams in the receiver guide rails. Of course, any foreign manner in the action can also cause this problem.

In the order they are listed above, here are the corrections:

- Replace ejection port cover.
- Replace magazine latch with one that assembles lower in the gun.
- Replace action spring.
- Replace ejector spring or clean ejector hole.
- Replace action bar assembly or clean up rivet head.
- Replace receiver, barrel, or bolt carrier, whichever is at fault
- Replace receiver.

Action Fails to Lock: The breechblock is improperly rotated forward, usually caused by a cartridge that is too long or a misalignment of the receiver, barrel, or bolt carrier. Try another cartridge of proper length; replace any of the faulty parts.

Look for a disconnector that binds the action bar and adjust it to hug the receiver wall if defective. If the extractor closes hard over the chambering cartridge, smooth up the extractor with an Arkansas stone or adjust the tension on the cartridge. Replace the extractor if necessary.

If the fault still persists, smooth up the ejector. Also disassemble and clean the ejector hole. Replace the ejector or spring if necessary.

If the breech jams in the receiver rails, try smoothing up the rails. If this doesn't work, the receiver will need to be replaced. A cartridge primer could have been pierced on a previous round. This primer or pieces of brass must be removed from the firing pin hole. Fouling in the barrel chamber is another possible cause. Clean the chamber, removing all grease and foreign deposits.

Fails to Fire: When the firing pin fails to indent the cartridge primer properly, either the firing pin is defective, the bolt carrier fails to close completely to the breechbolt, the cartridge brass is lodged in the firing pin hole, or the hammer fails to cock. In the order given above, correct as follows:

- Replace firing pin. Check the protrusion of the bolt face with the bolt carrier completely closed to breechblock.
- See corrections for "Gun Fails to Lock."
- Remove brass from the firing pin hole.
- Check right connector for proper seat at rear of sear. Check disconnector for proper engagement with the action bar in front and rear with proper engagement under the left connector. Check hammer and sear-notch engagement. Check hammer spring as well as the sear spring.

Fails to Extract: A broken extractor with only the nub remaining should be obvious. However, a tiny, hard — to — detect chip out of one edge can also cause extraction problems. Examine the extractor hook carefully under good light and, if small chips are noticed, try smoothing them out with a file or Arkansas stone. In most cases, however, it's best to replace them.

To test for a worn extractor which is not easily detected by a visual inspection, slip a cartridge case under the extractor and pull it straight away from the bolt face. It should be extremely difficult or impossible to free the shell if the extractor is good. If the cartridge slips away easily, you have a worn extractor which should be replaced.

Other common causes of extraction problems are broken or weakened extractor springs, broken pins, and foreign matter in the spring/plunger/extractor recesses.

Fails to Eject: Modern autoloading guns mostly use spring-loaded button ejectors mounted in the face of the bolt where a compressed spring forces the button or stud against the base of the cartridge, holding it in place until the bolt recoils all of the way to the rear. At that point, the stud tips the case out of the action. Malfunctions with this type of ejector are usually caused by a weak or broken plunger spring or debris in the plunger recess.

Fails to Lock Open: Most semiautomatics are designed so the action locks back after the last cartridge is fired. When the gun fails to do so, the magazine follower is probably defective and should be replaced. However, the breechbolt could be rounded too much on its front edge, or the magazine follower binds down at the rear or front ends. In these latter cases, the defective part or parts should be replaced. The troubleshooting chart in Fig. 11-6 should prove useful when troubleshooting semiautomatic rifles. Also, try to obtain gunsmithing information from the manufacturers.

Part No.	Part Name
MS00300	Barrel
MS01000	Bon
MS13200	Bolt Lock Assembly (with Buffer Spring)
MS06000	Bolt Lock Buffer Spring
MS06700	Bolt Lock Cover Plate
MS04500	Bolt Lock Plunger
MS04600	Bolt Lock Plunger Spring
B-63	Butt Plate (Plastic) I
	Butt Plate (Alloy)
B-64	Butt-Plate Screw (2 Req'd)
MS00800	Ejector
MS07000	Ejector Spring
MSO1400	Extractor
MSO1600	Extractor Plunger
MSO1500	Extractor Spring
MSO1100	Firing Pin
MS02200	Forearm Liner & Stock Cap Assembly
MS04400	Front Sight
MS07200	Front Sight Cross Pin
MS03500	Gas Block (Top & Bottom)
MS06500	Gas Block Screw (4 Req'd)
MS02500	Gas Port Bushing
MS03900	Guide Rod
MSO1700	Hammer
MSO1900	Hammer Pivot Pin
MS04700	Hammer Spring
MSO1800	Hammer Strut
MAG-5	Magazine. 5 Shot. Complete (not shown)
MAG-20	Magazine 20 Shot. Complete (not shown)
MS04000	Magazine Catch. Front
MS06600	Magazine Catch Retaining Pm
MS03100	Magazine Latch
M S01200	Magazine Latch Pivot Pin
MS05000	Magazine Latch Spring
MSO3600	Piston (Gas Pipe)
MS05501	Rear Sight Assembly. Complete
MS05500	Rear Sight Base
MSO7300	Rear Sight Elevation Detent Plunger
M SO5600	Rear Sight Elevation Detent Spring
M SO7400	Rear Sight Elevation Screw
MSO5300	Rear Sight Elevation Plunger
MSO5400	Rear Sight Elevation Plunger Spring
MS05700	Rear Sight Nut
MS05200	Rear Sight Peep
MS06100	Rear Sight Windage Detent Plunger
MS05800	Rear Sight Windage Detent Spring
MSO5900	Rear Sight Windage Screw
MSO7100	Rear Sight Windage Screw Pin
MS00100	Receiver
MS05100	Recoil Spring (Slide Spring)
MS 13800	Safety Assembly
MS04900	Safety Detent Spring
MS06200	Safety Spring Retaining Pin
M SO2300	Secondary Sear
MS02400	Secondary Sear Spring
MS23700	Slide Assembly
MS07500	Sling Swivel. Front
B-120	Sling Swivel Assembly Rear
MS00400	Stock (Wood w/Butt Plate attached)
MS00700	Stock Reinforcement
MS06900	Stock Reinforcement Screw (2 Req'd) (pair)
MS08000	Stock Reinforcement Lock Washer (2 Req'd
MS08400	Stripper Clip
MS02000	Trigger
MS04300	Trigger Bushing
MS00200	Trigger Guard
MS01300	Trigger Housing
MS02100	Trigger Pivot Pin
MS04800	Trigger Spring

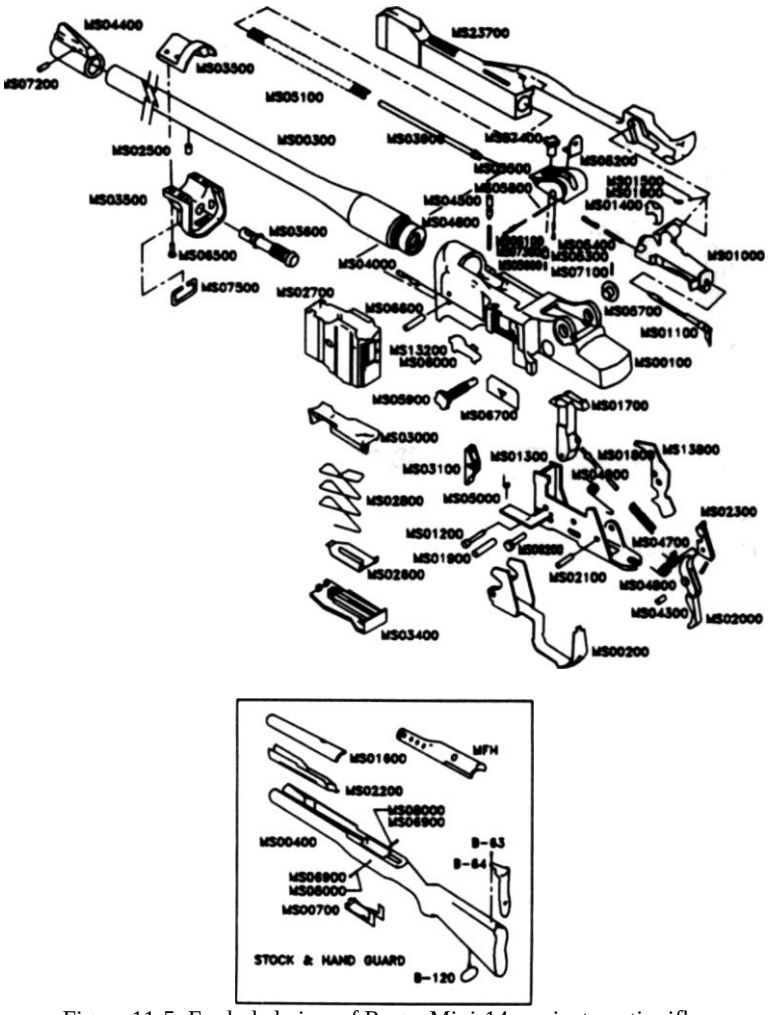


Figure 11-5: Exploded view of Ruger Mini-14 semiautomatic rifle.

TROUBLESHOOTING CHART
Centerfire Semiautomatic Rifles

Malfunction	Probable Cause	Corrective Action
Feeding problems	Distorted magazine	Replace magazine
Fails to fire	Broken or worn firing pin	Replace firing pin
Fails to extract	Broken or jammed extractor	Replace
Fails to eject	Weak or worn ejector	Replace
	Weak or broken ejector spring	Replace

Figure 11-6: Troubleshooting chart for semiautomatic rifles.

Chapter 12 - Break-Open Shotguns

The modern scattergun is versatile. In the hands of an expert hunter, and with the proper loads, it can account for all species of North American game, from fowl to bear.

Shotguns probably are used more for hunting than any other firearm in the United States and are available in several types from the inexpensive single-shot models, up through the repeaters and semiautomatics to the doubles — some of which are extremely expensive. Troubleshooting techniques will vary with each type.

Since shotguns are widely used throughout the world, it stands to reason that this type of firearm will frequently find its way into your gunshop for repairs or modifications. Consequently, you should have a good knowledge of the basic types; that is, how they function, what to look for when something goes wrong, and how to correct the problem once it is found.

The next few chapters are designed to review the operation of all types of shotguns. Furthermore, you will learn what to look for in various models when trouble does occur. Once the problem is found, all that is necessary is to correct the problem, following the instructions in this book. The numerous troubleshooting charts will also help you solve various shotgun problems quicker.

Single-Shot Shotguns

Almost every rural household in the United States has kept, at one time or another, a single-barrel shotgun propped in the kitchen comer within easy reach. Such guns accounted for numerous chicken hawks (often shot only steps from the back door) and sometimes human chicken thieves. The guns were inexpensive, easy to operate, and were more efficient than ·22-caliber rifles in the hands of inexperienced shooters.

Most of these “utility” guns were often abused — used for everything from a pry bar and protection weapon to a hunting firearm and canoe paddle. Still they functioned okay, even when their pump and autoloading brethren failed. While the single-barrel shotgun has nearly as many parts as the repeaters, the parts in the single barrel are not slammed around as much as those in a slide-action or semiautomatic gun. Many of these single shots are still around and in use after nearly a century of abuse. My grandfather’s 12-gauge Triumph single-barrel shotgun was purchased sometime around the turn of the century and still takes home an occasional ham from the local shooting matches.

Common Malfunctions

Figure 12-1 shows a sectional view of an Iver Johnson single-barrel ejector shotgun. Many of the hammer single-shot shotguns of this century are similar to this model in design and operation.

Although most single-shot shotguns are relatively simple in design, all will have their share of problems —due mainly to worn-out parts and misuse. Many repairs to correct these problems — like replacing a broken trigger spring — only take a few minutes, but some of them can be very time consuming and costly. Therefore, many of these old-timers are retired to the gun rack or scrap pile. A person with the knowledge, however, can repair one of these shotguns in his spare time and have a good utility gun to knock around the farm or camp.

Besides loose actions, the two most frequent problems occurring with this type gun are a broken trigger spring and a broken or weak locking bolt spring. The former is easily detected by the action of the trigger. If the trigger does not spring back after it is pulled, the problem is usually caused by a broken trigger spring. Of course, if a gun looks dirty, clean it before starting your diagnosis.

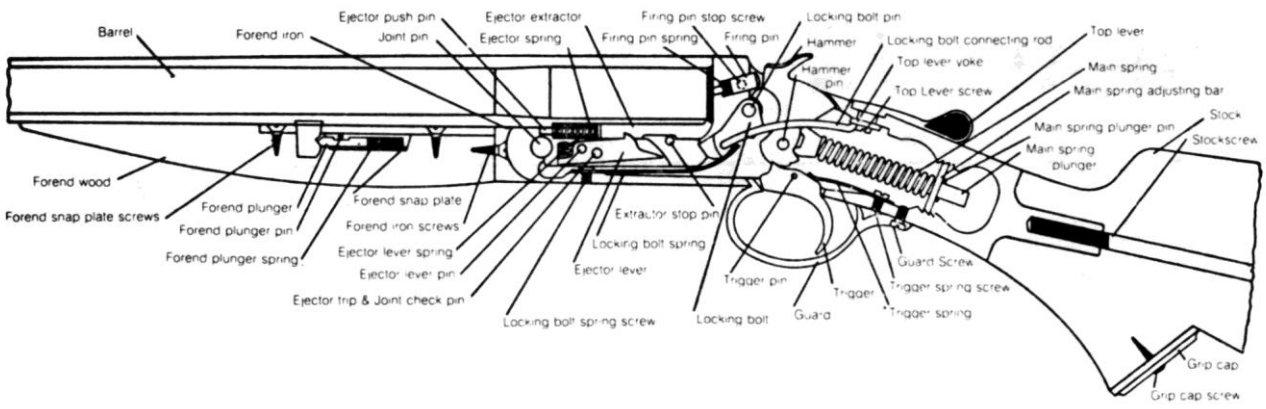


Figure 12-1: Sectional view of an Iver Johnson “Champion” single-shot, break-open shotgun. This design is similar to most break-open shotguns manufactured in the United States for the past 100 years.

The exact method of replacing the trigger spring might vary slightly with different brands, but taking the Iver Johnson in Fig. 12-1, first remove the buttplate, then with a long heavy-duty screwdriver (½″ shaft) remove the stock bolt. Be careful, since a wrong size screwdriver could slip, splintering out the side of the stock while exerting force.

Once the stock is removed, you will have a partial view of the inside of the receiver. Use a bore light to examine the inside of the receiver. You'll be looking for a flathead screw on the bottom tang under the mainspring. The view is not too good on this particular model, since the receiver sidewalls will be blocking your direct view from the sides, and the mainspring assembly will be blocking your view from the top. You might have to remove the mainspring assembly to get at the screw head, but try to avoid this if at all possible.

You may be able to get enough working room by sliding the mainspring adjusting bar in its notch slightly to the right or left. Then use a ratchet screwdriver to loosen the trigger-spring screw. Insert a new spring, with the curvature of the saddle positioned as shown in Fig. 12-1 and re-tighten the screw. Replace the mainspring-adjusting bar in its original position and then replace the stock and buttplate. The job should take about 15 minutes if you have a replacement spring on hand and if you don't have to remove the mainspring.

If the inside of the receiver is rusted — and it probably will be — use a good penetrating oil on the screw before extracting it You don't need a frozen screw — resulting in wrenching its head off—to add to the original problem.

The locking-bolt spring in most single-shot shotguns can be reached through the front of the receiver. Remove the forend, break it open, remove the barrel, and you may be able to reach it. On some guns, however, you will have to remove some of the "guts" in this part of the receiver to get at the locking-bolt spring and its screw; that is, ejector lever and the ejector/extractor.

The symptoms of a loose or broken locking-bolt spring include a very loose top lever movement (one which does not align with the rear tang); play in the up-and-down barrel movement when the action is supposedly locked; and the barrel opening automatically upon firing without touching the top lever. A factory replacement spring here is best, but if the parts are not available, one can be made by conventional methods.

A worn or broken firing pin is another common problem with many of the older shotguns. The pin is easily replaced (if a replacement is available) by removing the firing pin stop screw — being careful not to let the remaining firing pin and spring fly out and become lost — and slipping the firing pin and spring out of its channel. Replace with a new one in the reverse order.

When a single-shot shotgun misfires, it is usually due to the firing-pin spring being either worn or broken. These coil springs in single-barrel shotguns are very tough and seldom break, but after years of use they may become weak. Most of the time, more tension can be added to the spring (enough to enable the hammer and firing pin to do their jobs) by moving the mainspring adjusting bar another notch or two closer to the hammer. If this doesn't do the trick, then a new spring will need to be installed.



Figure 12-2: Extractor/ejector on a single-barrel shotgun. It slightly raises an unfired shell when the barrel is pivoted open, and completely kicks out a fired shell.

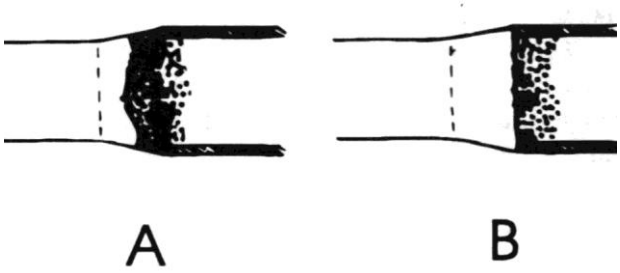


Figure 12-3: The effect of short chambers is depicted above. (A) In short chambers, the fired shotshell crimp bottlenecks when the shot (and crimp) enters the forcing cone of the chamber. (B) A correct chamber in which the crimp of the fired shotshell case opens completely, allowing no restriction to the shot pattern. Chamber pressures are also kept to the bare minimum, and recoil is less when shotguns have correct chambers.

The only other springs normally found in this type of gun are the ejector-lever spring and the ejector spring. Both seldom break but, when they do, replacement springs are easily made from coil-spring stock.

Any of the above repairs can be performed at very little expense. However, the description of the problems to follow may be a different story. You will have to weigh each repair and then decide if an inexpensive single-barrel shotgun is worth the time and expense.

One of the main and more complicated problems that occurs with the older single-barrel shotguns is a loose action. To check for looseness, hold the gun with one hand on the forend and the other on the buttstock at the grip. By twisting your hands in opposite directions, you should be able to detect any play that might be present. Try this check to the sides and up-and-down.

Headspace problems are another common fault with older single-shot shoguns. Hold the gun up to a light source so that you can sight at the gun where the barrel meets the standing receiver or breech. If you can see light through this gap with the action closed, the gun is probably dangerous to fire. A feeler gage may also be used to measure the exact dimension of the gap.

The next problem is short chambers. Over the years, there have been a variety of standard chamber lengths for the shells that were manufactured when the gun was built. Most of them were less than 2·760″ overall length — the minimum dimension to handle the overall length of today's plastic shells. Because of these obsolete chambers, the already-weak action takes an extra beating due to the higher pressures caused by these short chambers. The shell's crimp must have room to unfold completely flat when the shot and wads go from the case to the bore. Any little bit of case forced into their path because of a short chamber will deform the shot, tear hulls, cause excessive recoil, and raise chamber pressures above normal. See Fig. 12-3.

The final problem is choke. Many of these old single-shots had long 32″ to 36″ barrels that were tightly choked. This is why many of these old guns — like the Winchester Model 37 — are still coveted by persons in certain types of shooting matches. Some of these guns, however, in an effort to "modernize" them, had their barrels cut off to, say, 26″, leaving the barrel with no choke at all. They work fine on rabbits and quail at close range, but beyond about 30 yards their shot pattern is so thin that few kills are made.

Short Shotgun Chambers: Short shotgun chambers (Fig. 12-3) can be reamed out by using a special reamer. This chambering reamer cuts short chambers to modern length and reams a new, long forcing cone at the same time without lengthening the chamber. They are currently available from Brownells Inc. for 12, 16, 20 and ·410 gauges. Complete instructions accompany the reamers when they are requested with the order.

In general, the shotgun barrel is tightly secured in a vise with the muzzle pointing toward the floor and the chamber end up, just slightly above the vise jaws. A good cutting oil is used in the chamber for the lubrication, and the chamber reamer is inserted lightly into the chamber. A T-handle wrench is used to turn the reamer one complete revolution in the chamber. The reamer is then removed while still turning it clockwise (never back a reamer out by turning it counterclockwise), the chamber is cleaned of all oil and metal shavings, then a measurement is taken. Continue this procedure — cleaning the chamber and reamer each time before continuing — until the desired chamber length and/or forcing cone is cut.

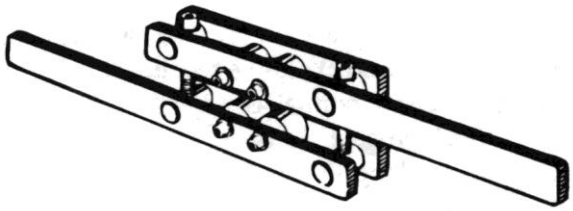


Figure 12-4: B-Square barrel swager to swage any degree of choke desired.

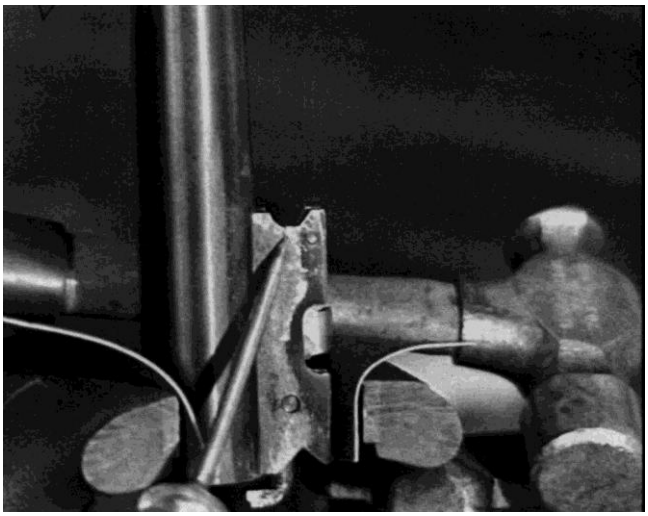


Figure 12-5: A temporary remedy for a loose single-barrel shotgun action is to peen lightly around the semicircular cutoff.

Chokes: A choke may be put back into shotguns, but it takes some time, skill, and effort to do so. Many gunsmiths will charge $45 to $100 to choke a shotgun barrel, and once the job is done, if all you have is a $50 shotgun, is it worth it?

Shotgun chokes are normally cut to the desired measurements with an angle-blade expanding choke reamer checked with barrel calipers, then honed smooth with a shotgun barrel hone. Barrels on inexpensive single-shot shotguns are frequently choked with a barrel swager which reduces the inside muzzle diameter. A swage offered by B-Square is constructed of heavy-duty steel to transmit power to the adjustable rollers which can swage any degree of choke desired. More recently, integral choke tubes have become quite popular and can often be installed for about the same price as other chokes.

Loose Actions: The best remedy to correct a loose action is to replace the worn pivot pin. Since the strength and functioning of the action depend a great deal on this pin, care must be exercised during the job. Even then, it is a difficult and time-consuming operation on many brands of single-shot shotguns.

With the pin already in the action, it would be difficult to heat the outside of the hole and cool the pin at the same time. More than likely, the old pin will have to be drilled out using a bit slightly smaller than the pin. The remaining metal in the hole can be reamed out, but be careful not to enlarge the original hole.

The new pin should be made of hard chrome-alloy steel, turned on a lathe to a diameter of about ·001″ larger than the finished hole, and slightly tapered for a start at one end. The frame should be shipped of all parts that will be affected by the heat, then heated just to the point of changing color — about 400 degrees F. While reaching this temperature, the pin should be immersed in ice water to contract it, and when the correct temperature is reached, the new pin should be removed from the ice water and quickly driven into the hole in the heated frame. When both parts have cooled, the result should be a very tight fit If any metal protrudes on either side of the frame, it should be ground off, filed, and polished smooth on the buffing wheel. This operation will no doubt damage the original finish and will probably require refinishing (case-hardened or reblued) once the pin has been installed.

If the above operations were done by a professional gunsmith, the costs would probably exceed $200. Therefore, such restoration work can only be justified on a single-shot shotgun with sentimental value; the gun's actual value would come nowhere near this amount.

On the other hand, an old single-shot shotgun might be a good candidate for the student or advanced hobbyist to practice on. Just the above operation will give the worker experience in lathe operations, metallurgy, and bluing and/or case-coloring.

If the looseness is not too bad, it can often be corrected by peening lightly around the semicircular cut-out on the barrel lug as shown in Fig. 12-5. If done correctly, the metal will be displaced and moved slightly forward to close the gap. Peen both sides with a block of steel under the lug. When the pivot-pin junction is tight, smooth the sides of the lug where the opening has been done with a fine pillar file.

Double-Barrel Shotguns

Before the advent of the repeating shoguns, the double-barrel, side-by-side shotguns were the only way available to get off a second shot at a covey of quail or a flock of low-flying ducks over decoys. Thus, the double side-by-side was the most popular hunting firearm around the turn of the century until repeating shotguns came into production. Then repeating shotguns and semiautomatics started to boom. Today, more hunters use semiautomatic shotguns for hunting than any other type.

Still, for upland game shooting many hunters consider a light double in either 12 or 20 gauge the ideal shotgun. Doubles handle and point nicely, aren't bulky, and most weigh quite a bit less than their semiautomatic or pump counterparts.

Double-barrel shotguns include both the side-by-side and over/under guns. Drillings or three-barrel guns are essentially a double-barrel shotgun with the addition of a single-rifled barrel under and centered on the shotgun barrels. Troubleshooting techniques applying to double-barrel shotguns would certainly apply to drillings also.

Operating Characteristics

Most double-barrel shotguns have either a boxlock or sidelock action. In general, the boxlock contains all of its working parts within the lock or action, while a sidelock contains all of its working mechanism, except for the trigger, in a separate metal plate fitted into the side of the action body.

A double-barrel shotgun is similar to the singleshot, break-open shotgun except that there are two of everything: two barrels, two hammers, two mainsprings, etc. On modern double shotguns, the hammers also cock upon opening the barrels. When the barrels are dropped, levers pivot, pressing the hammers back against the spring tension to full-cock position.



Figure 12-6: A sidelock, containing the working mechanism, for an old, exposed hammer, side-by-side shotgun.

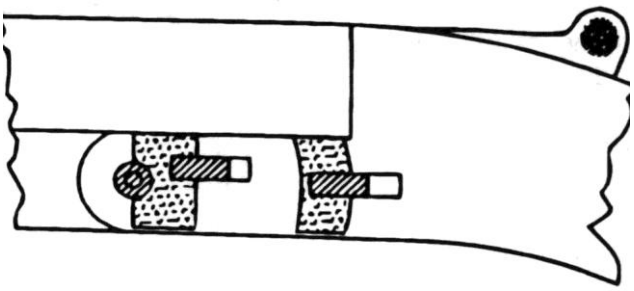


Figure 12-7: Purdy underbolt locking system.

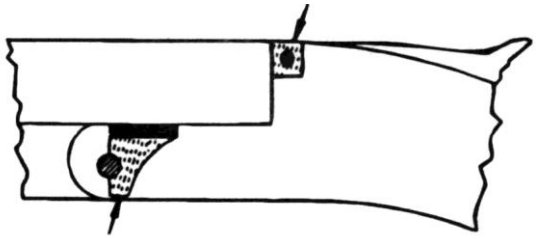


Figure 12-8: Sectional view of the Greener crossbolt system.

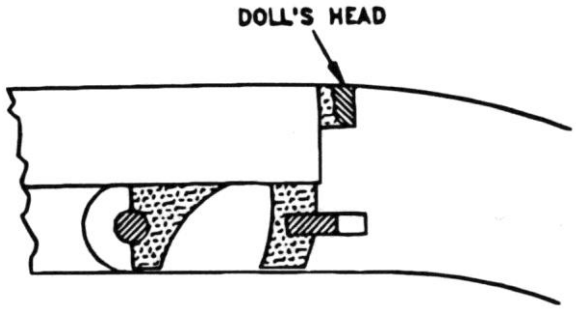


Figure 12-9: The doll's head locking system utilizes a circular protuberance of the end of the barrel which fits into a matching recess in the top of the receiver.

The barrels pivot on a crossbolt or hinge pin similar to the single-shot shotgun. However, the locking mechanism varies widely in double-barrel shotguns.

The Purdy underbolt system is characterized by a flush joint between the breech end of the barrels and the standing breech. The lock-up is accomplished by a sliding bolt which is cammed forward and backward by the top or tang lever (Fig. 12-7). When the lever is pressed to one side, the bolt slides out of the notches cut in the barrel lumps, permitting the action to open. When the action is closed, the lever is moved in the opposite direction.

The Greener crossbolt system uses an extension at the end of the barrels which swings in and out of a recess in the receiver (Fig. 12-8). When the gun is closed, a crossbolt enters the hole in the extension to lock the barrels firmly in place. When the top or tang lever is pressed to one side, the pin is released or cammed out the extension hole to free the barrels.

The doll's-head locking system utilizes a circular protuberance at the end of the barrels (Fig. 12-9) which fits into a matching recess in the top of the receiver. Although no crosspin is necessary with this type of locking system, some doll's-head guns are reinforced with locking pins.

The rotary-bolt system is considered one of the finest shotgun-locking systems in existence. With this system, a heavy-barrel extension with a rectangular cutout is engaged by a notched cylinder or bolt. The engaging surfaces are tapered to provide firm lock-up even with progressive wear.

Some European gunmakers utilize a locking system known as matching tapered dowel-pin system. Spring-loaded tapered steel pins protrude at either side of the standing breech. When the action is closed, the pins retract and then engage matching recesses in the butt end of the barrels.

Malfunctions

Most of the malfunctions described for the single-shot, break-open shotgun also apply to double-barrel shotguns; that is, action looseness, broken mainsprings, firing pins, etc. The remedies are essentially the same as discussed previously.

One type of malfunction that is sometimes encountered is the inadvertent firing of both barrels. This problem especially prevails in older European double-barrel guns where hammers and sears are made with soft steel. With age and wear, the trigger/sear contact becomes poor, and when one barrel is fired, the second barrel is jarred off at the same time.

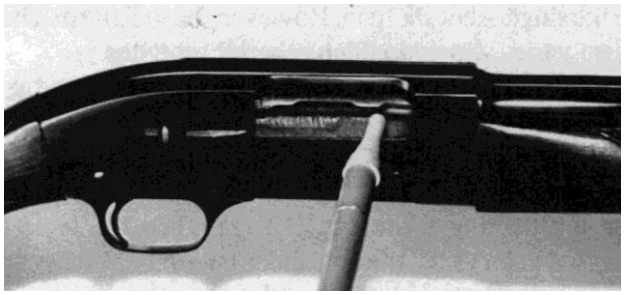


Figure 12-10: A bore light is very useful for examining the inside areas of shotgun actions.

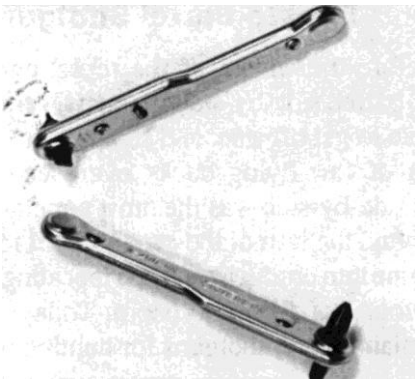


Figure 12-11: A ratchet screwdriver can be a life-saver to loosen screws in hard-to-reach places.



Figure 12-12: To check for looseness in either a single-barrel or double-barrel, break-open shotgun, hold the gun as shown and twist your hands in opposite directions. Any play should be readily detected.

The problem of both barrels inadvertently firing can sometimes be corrected by inspecting the sears with a magnifying glass and truing-up any rounded surfaces by light honing. Since shotgun sears ride in extremely shallow grooves, usually only minor polishing is required to smooth, lighten, or heavy-up the trigger pull. However, if the contact points are badly worn, they may have to be re-cut, polished, and heat-treated. If this still does not solve the problem, the sear may have to be cut off, a new piece of heat-treated steel silver-soldered in its place, reshaped and polished. The problem may also be corrected by welding.

Rough trigger pulls may also be corrected by lightly honing the sear/hammer contact points, but go easy. Never allow a shotgun to have a "hair trigger." Many have discharged from merely bumping the butt against the ground. Remember, too, that any time much metal (the rest of the paragraph is missing in the book).



Figure 12-13: The gap between the barrel and the standing breech is only ·002 inch, but the gun is still dangerous to fire.

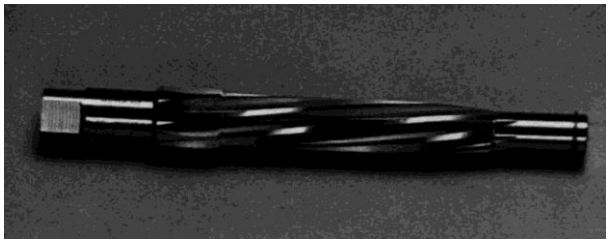


Figure 12-14: Shotgun chamber reamer for lengthening short chambers and cutting new forcing cones.

Never allow a shotgun to have a “hair trigger.” Many have discharged from merely bumping the butt against the ground Remember, too, that any time much metal is removed from a sear surface, it’s likely that the case hardening has been removed. In this case, the part must be heat-treated.

Exploded views, like the one in Fig. 12-15 can be extremely helpful when disassembling shotguns for the first time.

The troubleshooting chart in Fig. 12-16 gives a list of malfunctions common to both the single-shot and double-barrel shotguns. The probable cause of these mal- (the rest of the paragraph is missing in the book).

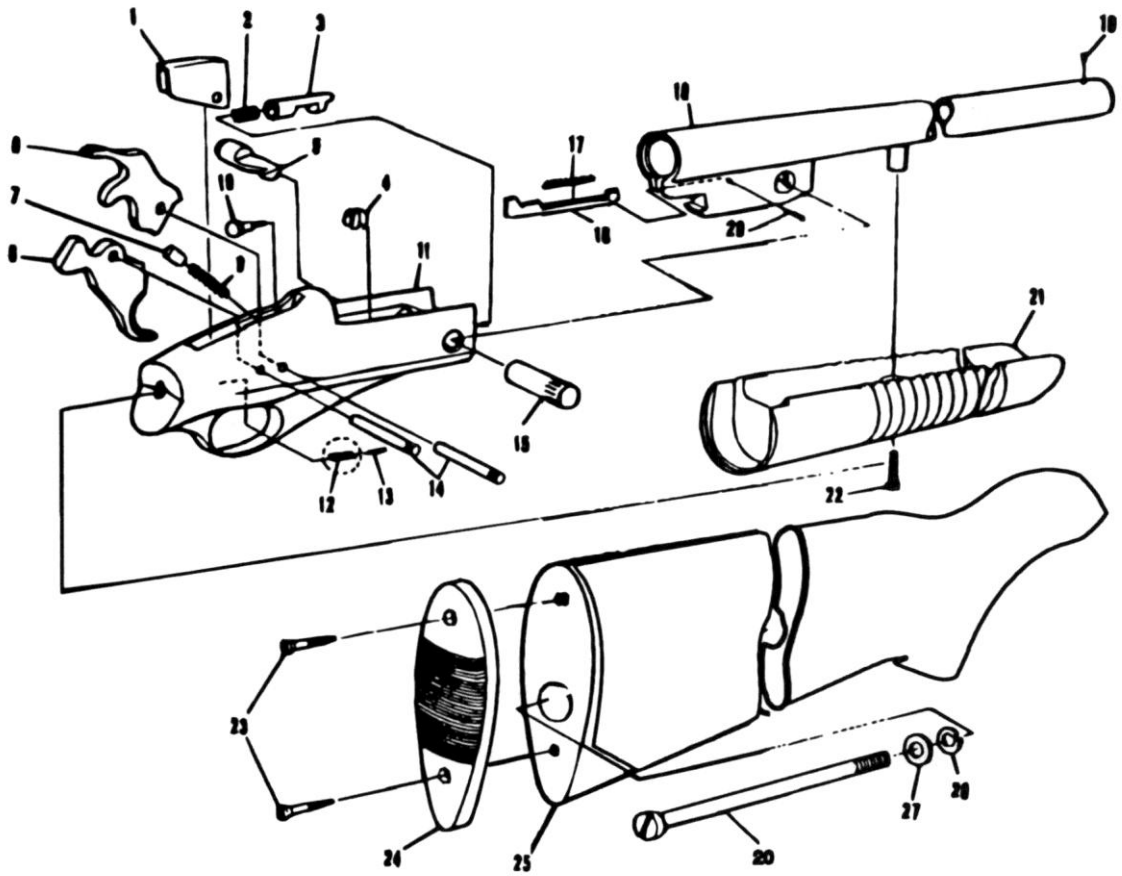


Figure 12-15: Exploded views of firearms can be extremely helpful during the disassembly/assembly process.

TROUBLESHOOTING CHART
Single-shot and double-barrel shotguns

Malfunction	**Probable Cause**	**Corrective Action**
Fails to eject	Broken or weak ejector spring	Replace spring
	Debris in extractor/ejector mechanism	Clean thoroughly
Loose fore-end	Fore-end plunger spring weak or broken	Replace spring
	Fore-end iron loose	Tighten
Trigger fails to reposition	Broken trigger spring	Replace
Fails to lock properly	Locking bolt spring broken or worn	Replace
	Bent or worn joint pin	Replace pin or peen barrel humps to tighten around pin
Fails to fire	Worn or broken firing pin	Replace
	Weak or broken mainspring	Replace

Figure 12-16: Troubleshooting chart for break-open, standing-breech shotguns.

Chapter 13 - Slide-Action Shotguns

In the late 1800s, the Winchester Repeating Arms Co. introduced the first successful repeating shotgun. The gun was designed by John Browning and was lever actuated. This was known as the Winchester Model 1887 repeating shotgun, and with a magazine capacity of four shells, plus one in the chamber, the shooter had a total of five shots which could be fired as fast as the lever could be operated. This, however, was its downfall; the lever action was too slow and the gun was heavy and bulky.

Winchester and Marlin then popularized slide-action or "pump" shotguns known as the Winchester Model 1893 (a later version was known as the Model 1897) and the Marlin Model 17.

The pump-action was faster than the lever-action, plus the movements involved in using the forend as a "pump" did not affect the sighting capabilities as drastically. The slide-action was here to stay!

By the early twentieth century, Winchester had developed its Model 12, which is the oldest continuously produced hammerless shotgun with a slide-action. Since its inception, this shotgun has been produced in almost every shotgun configuration from duck gun to trap gun.

Remington also produced pump shotguns starting around 1907. The original Remington ejected spent shells from the bottom of the receiver, and was known as the Remington Model 10. Many shooters believed the Model 10 action to be smoother than the Winchester, and it was definitely quieter. The present Remington Model 870 is a very smooth action even though it was designed as a labor-saving action as far as manufacturing is concerned.

The slide-action in a shotgun, like the Model 870 Remington, is actuated by the movement of the forend. When the forend is pulled back, a lever that attaches to the bolt moves rearward. The movement of this lever ejects the spent shell and at the same time pushes the hammer back. The hammer engages a special sear that holds it in the cocked position. While the pump lever is being moved rearward, it also moves a new shell onto the carrier. The carrier is actuated by the bolt, which in turn is actuated by the lever attached to the forend. When the bolt is in its rearward position, a special cam — the carrier dog — allows the carrier to drop down to the level of the magazine. With the carrier in this position, the new shell that is moved into position by the pumping action can be picked up. As the bolt moves forward, the carrier dog is forced down, pushing the back end of the carrier down in a seesaw fashion and causing the front of the carrier to lift the new shell up to the breech. When the forend is moved forward the rest of the way, the bolt pushes the new shell into the chamber. When the bolt reaches its extreme forward position, a special locking block closes into position making the action ready for firing.

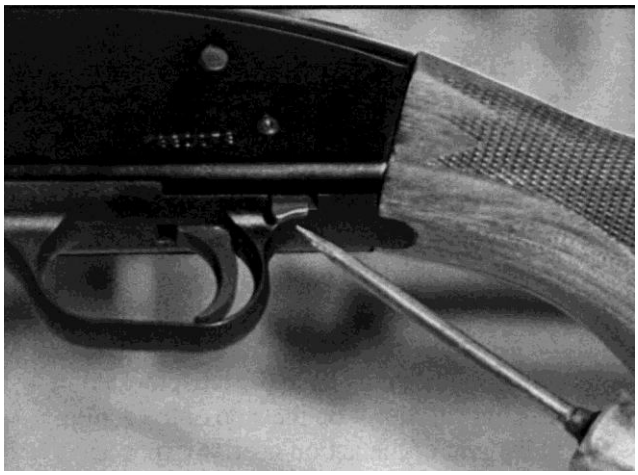


Figure 13-1: Lock-release on slide-action shotguns enables the slide to be operated without firing the gun.

Malfunctions

The biggest single cause of a malfunction in other repeating firearms holds true for pump shotguns; dirt, dust, and assorted debris when combined with gun oil and grease prevent the proper operation of the many different components. Other common malfunctions include failure to feed property, double-feeding, magazine failure to retain shells, headspace problems, action jams, action failing to lock, failure to extract or eject, gun failing to fire, hammer failing to cock, gun firing on closing the action, safety sticking, and cracks or seams on the bolt face. Also, badly pitted chambers and barrels are relatively commonplace on some of the older models which were used before the invention of noncorrosive primers.

Initial inspection: When a pump shotgun is cleaned or in the shop for repairs, the mechanism should be tested for proper functioning. However, during this initial test, live ammunition should not be used. When dummy rounds are not available, fired shells may often be used for testing by turning in the uncrimped end so that the length of the shell will be approximately that of a live shell. If handloading equipment is available, dummy round may be produced by taking fired cases and leaving the fired primer intact. Fill the powder compartment of the shell with dry white sand, insert a wad over the sand, then load the remaining portion of the shell with shot in the normal way — including proper crimping. This will make an excellent dummy round for testing shotguns. You should have five rounds each of the various gauges.

To test pump shotguns, operate the gun in the following manner

- With the sliding breech locked and the hammer cocked, push the operating handle slightly forward, and press in on the slide lock release. On the Winchester Model 12, Stevens Model 620, and others, this slide lock is on the left rear of the trigger guard. On Ithaca Model 37 shotguns, this slide-lock release latch is at the right side of the forward end of the trigger plate guard bow. Other models may have the latch located in other positions — on the side of the action, at the rear of the action near an exposed hammer, etc. — but in all cases the release will be a spring-operated button that depresses inward. With the slide lock release button depressed, pull the operating handle fully and smartly to the rear and then push it fully and smartly forward. Reciprocate operating the handle several times in the same manner to test for the smoothness of the action.
- Retract the operating handle again, release the slide-lock release, and push the operating handle smartly forward to lock the sliding breech. Then attempt to retract the operating handle. The operating handle should not retract.
- Pull the trigger, allowing the hammer to move forward to the fired position, and attempt to retract the operating handle. The operating handle should retract.
- Retract the operating handle fully and then push it forward until the sliding breech is fully forward but not locked and the locking block not fully engaged. Then pull the trigger to release the hammer. The hammer should not be released until the sliding breech is fully locked and the locking block is fully seated in its aperture.
- Place two or three dummy rounds in the magazine and work them through the action to test the gun for feeding, loading, extraction, and ejection of shells. The second shell should not leave the magazine until the first shell has been loaded into the chamber and the sliding breech is locked behind it.
- With the sliding breech locked and the hammer in the cocked position, slide the safety all of the way to the right or ON position and attempt to pull the trigger. The trigger should not pull nor the hammer release. Try bumping the butt stock on a solid surface to see if the hammer will release or if the safety will be bumped to the off (firing) position.
- Slide the trigger safety to the off position and pull the trigger. The trigger should pull and the hammer be released to fire the gun.

If everything checks out during the preliminary inspection and the gun looks tight and in safe working condition, you may wish to test fire the gun with three rounds of live ammunition to insure that the gun will fire during actual operation. However, never test fire a questionable firearm until it is checked over thoroughly.

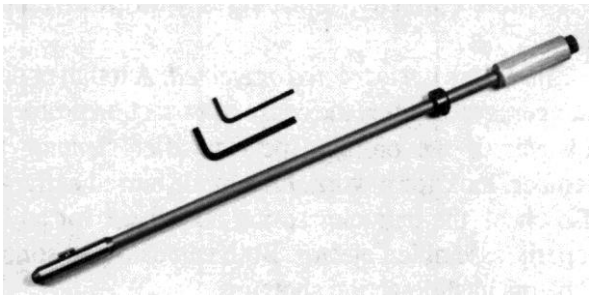


Figure 13-2: Brownell's hydraulic dent remover.

Troubleshooting Slide-action Shotguns

When the gun does not operate and function as it should during the preliminary inspection, damaged or improperly assembled parts are the most probable causes. Here are a few of the more common problems, causes, and solutions.

Operating handle sticks: When the forend cannot be easily moved forward or backward, the cause is often foreign matter in the receiver recesses. A bent or battered slide handle (the rear extension of the action slide) may be the culprit. Also check for burrs in the bar slot in the receiver or barrel head. A magazine may sometimes be dented enough to jam the action by binding the slide.

Clean and degrease the operating mechanism thoroughly, then check the action bar for bends or marring. If the action bar is damaged, the judicious use of a hammer and file will often correct it. Burrs in the bar slot in the receiver or barrel head may be removed with a file or Arkansas stone, but proceed with caution, as the stoning process must be exact with no change in the angle of the faces and the volume of metal must not be materially reduced.

Dents: Dents in the magazine tube can cause a feeding problem and if much work is encountered in raising dents in shotgun barrels and magazine tubes, you may want to consider purchasing a hydraulic dent raiser. This tool is actually a hydraulic jack of tremendous force with pressure controlled by the T-screw in the handle. Because of the pressure involved, the best of steels and heat-treating procedures have been used in its production to insure ease of maintenance and years of trouble-free use.

Operating the dent raiser is quite simple. Hold the tool on the outside of the barrel so that the small anvil in the tool head is even with the center of the dent in the barrel. Slide the collar so that it touches the barrel breech or muzzle (depending upon which end of the barrel you intend to insert the tool). Then lock the collar in place with an Allen wrench—making certain that it is firmly locked.

Now insert the dent raiser into the barrel to the depth of the locking collar so the anvil will be at the center of the dent. Gently turn the T-screw in and watch the dent come up. When the dent is completely up (you must be careful not to bulge the barrel because the tool is so powerful), relieve the hydraulic pressure against the anvil by loosening the T-screw. Reapply pressure until resistance is just felt and you can turn the tool handle back and forth without too much pressure. Turn the T-handle and twist and burnish. Repeat until the dent is completely removed. With this tool, no outside hammering or peening is required.

Sliding breech does not lock: This problem may be due to foreign matter on the face of the sliding breech, in the extractor grooves in the barrel head, or in the locking block aperture in the sliding breech. If cleaning and degreasing doesn't correct the problem, look for a broken firing pin or burrs on the edges of the locking block or locking aperture in the receiver.

A broken firing pin should, of course, be replaced. If burrs are present, carefully hone these away with an Arkansas stone and plenty of honing oil.

Hammer does not cock properly, or slips: This condition may be due to burrs or foreign matter on the sear hooks of the hammer or sear, worn or broken hooks, missing or improperly assembled parts in the trigger mechanism, or a broken mainspring.

If cleaning does not solve the problem, deepening the notches with a file may help; otherwise the parts will have to be replaced. Check the assembly drawings to see if all trigger mechanism parts are assembled correctly. Replace any broken parts.

Firing pin does not retract into sliding breech: Check for a broken firing pin and burrs on the firing pin or locking block. Replace a broken firing pin. Remove burrs with emery cloth and honing stones.

Slide does not go fully forward: Check for debris in the slide apertures. The problem may also be caused by a jammed locking block or a jammed slide plunger. Less frequently, you will find that a broken firing pin may be causing the trouble.

Thoroughly clean and degrease the gun, then check to see that all parts of the mechanism are assembled properly. Look for worn or broken parts and replace any that are defective.

Slide lock does not function: The most probable cause of this malfunction is a bent slide-lock release spring. However, if this is not the cause, look for burrs on the rear of the slide and also on the slide lock. The slide lock may also be bent.



Figure 13-3: Broken extractor in this shotgun was the cause of extracting/ejecting problems.

Replace the slide lock release spring if this is the instigator of the trouble. Burrs may be removed, as before, with a file and Arkansas stone. Straighten the slide lock with a hammer and file it if it is bent

Slide does not retract fully: This malfunction may be due to a broken hammer, an improperly assembled mainspring, an improperly assembled stock tank, and, in some cases, a broken firing pin.

Disassemble the gun and check for improperly assembled parts as well as worn and broken parts. Reassemble correctly, replacing any worn or broken parts.

Shells are not extracted or ejected: A rough or dirty chamber is most often the cause of extraction problems. However, if the problem persists after cleaning the chamber, look for a worn, broken, or burred extractor. Also check the extractor spring and check for an improperly assembled ejector. Both can cause all sorts of problems in slide-action shotguns.

The chamber may be cleaned with a power drill and a brass chamber brush or bore-polishing rod. Also remove any caked dirt that may be found in the extractor recesses. Burred parts should be smoothed with a file and honing stone. Missing, broken, or worn parts should be replaced.

Barrel removal: When barrels must be changed on repeating shotguns like the Winchester Model 12, 97, etc., the tools shown in Appendix II will be a big help. Operation of these tools are also shown.

Two shells feed into receiver at once: Double-feeding is usually due to a bent, sticking, or broken shell stop or else a loose shell-stop screw. Caked debris in the shell-stop seating grooves can be the cause of the problem.

If the problem persists after thoroughly cleaning the gun, straighten a bent shell stop by hammering it against a flat steel block (anvil). Replace it if it is broken or badly worn. If replacement parts are not available, sometimes the part can be repaired by brazing. Check the shell-stop screw and tighten it if necessary.

Shells stick in magazine: A corroded or bent magazine follower is the most probable cause of this malfunction, but a dented tube, broken or weak magazine spring, or dirt in the magazine are all possibilities; it's a matter of using the process of elimination until the problem is found.

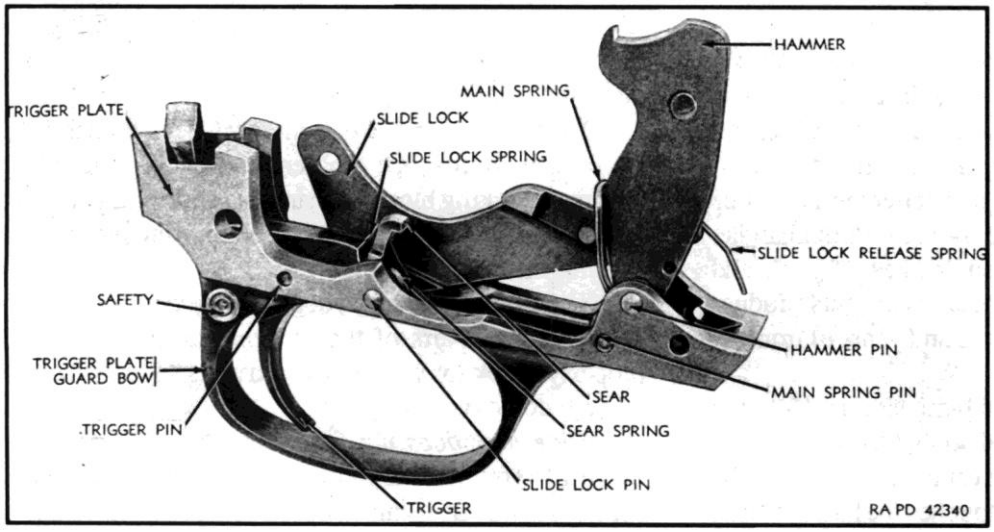


Figure 13-4: If the safety locks, look for residue in the safety slots.

Clean any corrosion from the magazine and remove any dents. The magazine can usually be straightened by driving a dowel (slightly undersized) into the magazine tube. Dents are removed as discussed previously, and worn or broken parts must be replaced.

Trigger safety sticks: If the problem isn't caused by gummy residue in the safety slots, the problem is usually caused by a worn or burred carrier-plunger spring. A jammed or rusted trigger spring can also cause the hang-up.

After cleaning the safety and related parts, check the areas for burrs; remove any burrs by honing or polishing. Also replace any missing, worn, or broken parts.

See the troubleshooting chart in Fig. 13-5 for several problems that develop in slide-action shotguns; use the appropriate corrective action.

TROUBLESHOOTING CHART
Slide-action shotguns

Malfunction	**Probable Cause**	**Corrective Action**
Action-slide lock does not function	Bent or broken action-slide lock spring	Replace
	Hammer pin driven in too far (protrudes)	Adjust hammer pin
	Bent cartridge cutoff	Straighten cartridge cutoff
Breechbolt jars down (while in process of takedown)	Weak breechbolt retaining lever	Replace retaining lever
	Breechbolt retaining lever cut in receiver worn or upset	Return to factory for inspection
	End of action slide which trips retaining lever worn	Replace action slide
Loose takedown	Engagement between receiver and receiver extension worn	Turn adjusting sleeve one or more notches counterclockwise to tighten draw
Breechbolt does not lock or closes hard	Extractors enter chamber	Replace extractors if upset
	Shallow counterbore in chamber ring	Counterbore chamber ring
Firing pin does not retract in breechbolt; also misfires	Bent ejector	Bend slightly or replace ejector
	Foreign matter in breechbolt (usually heavy oil or grease)	Clean
	Burred or broken retractor	Replace retractor
	Broken firing pin	Replace firing pin
	Weak, bent or broken retractor spring	Replace spring

Figure 13-5: Troubleshooting chart for slide-action shotguns.

Malfunction	Probable Cause	Corrective Action
Shell fails to extract and eject	Worn, burred, or broken extractors	Replace extractors
	Weak or broken ejector	Replace ejector
	Weak or broken extractor springs	Replace extractor springs
	Excessive headspace	Replace barrel
Shell sticks in magazine	Cartridge cutoff out of position	Adjust cartridge cutoff
	Corroded or bent follower	Repair or replace follower
	Dented magazine tube	Remove dent or replace magazine tube
	Magazine tube out of round	Replace magazine tube
	Kinked or broken magazine spring	Replace magazine spring
Double feeds	Cartridge cutoff arch up too far	Bend down arch on cartridge cutoff slightly until it functions properly
	Improperly assembled cartridge cutoff in receiver	Insert properly in receiver
Shells fail to feed on carrier from magazine	Cartridge guide out of alignment	Align cartridge guide
	Action slide lock bent or out of alignment	Align action slide lock
	Carrier spring weak, dropping shell out of gun	Strengthen carrier spring or replace
	Weak magazine spring in tube or binding follower in magazine tube	Replace magazine spring or magazine tube

Figure 13-5: Troubleshooting chart for slide-action shotguns (Continued).

Chapter 14 - Semiautomatic Shotguns

John M. Browning invented the first successful semiautomatic shotgun around and sold the rights to Remington to market the gun in the United States. The shotgun was sold as the Remington Model 11 in America, while Browning retained the rights to sell it throughout the rest of the world as the Browning automatic which, with a few modifications, is still sold today by the Browning Arms Company. Nearly all semiautomatic shotguns operate on the same principle as the initial Browning; that is, recoil action operated by the energy generated by the recoil.

Basically, the recoil method can be separated into two separate groups: long recoil and short recoil. The original Remington Model 11 used a long-recoil system, while the Browning double automatic and the Winchester Model 50 — to name a few — use the short-recoil method.

With the long-recoil type, barrel and breech are pushed back while still in contact with one another until they reach the rear of the shotgun. When the barrel and breech reach this rearward position they separate, with the barrel pulling itself forward. As the barrel moves forward it pulls away from the expended shell case which is held in contact with the breech by a set of double extractors. As the barrel reaches its original position, the shell is ejected by a special spring that is attached to the barrel. When the barrel is moving forward, it trips a mechanism allowing the breech to move forward caused by a spring in the stock which is compressed when the breech and barrel move rearward. When the breech is moving forward, it picks up a new shell and pushes it into the chamber. The gun is then ready to fire (Fig. 14-1), and will continue to fire each time the trigger is pulled until the magazine is empty.

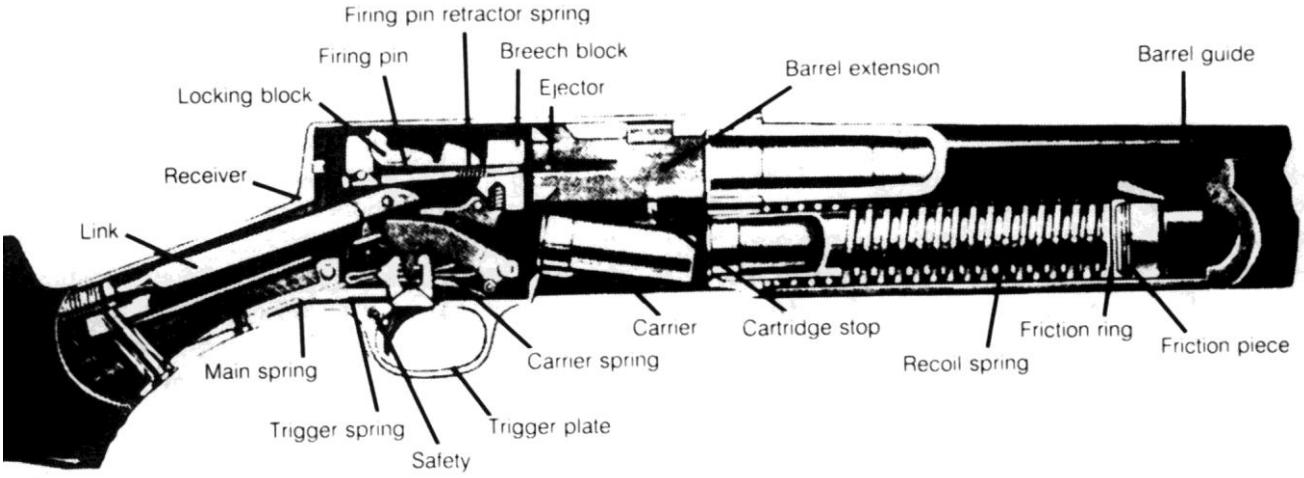


Figure 14-1: Browning long-recoil system—the basic system for all autoloading shotguns for a long time.

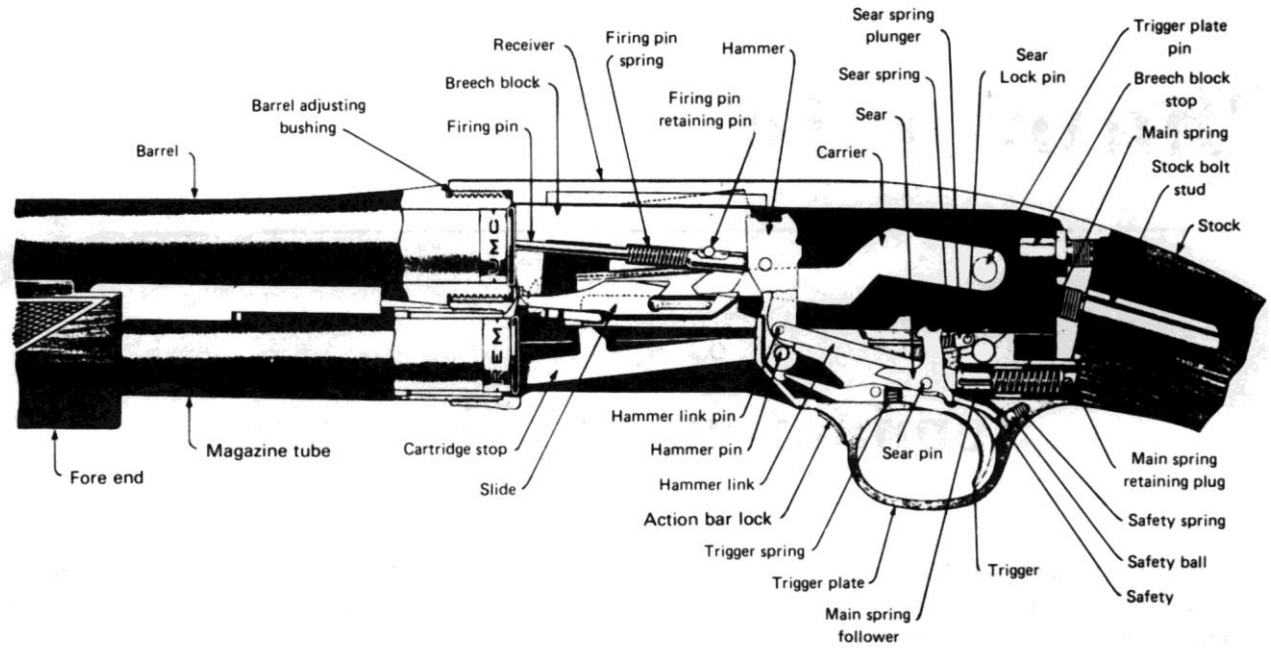


Figure 14-2: Short-recoil system used in the Browning double automatic and the Winchester Model 50.

Since the long-recoil shotgun has a two-part recoil, many shooters complain of the double-kick effect. When the shell is fired, the shooter feels the kick, but there is a second kick when the barrel and the breech slam home. Since all of the movements are controlled by the adjustments on the various springs that are involved, mis-adjustment can cause some rather jolting recoils. Having the adjustment rings in the wrong position when firing the high-powered shells makes the situation even worse.

To lessen the effects of the double-recoil. Browning and Winchester use a short-recoil system. With the Browning double automatic, the barrel only recoils about ⅝″, just enough to start the action moving. Winchester, on the other hand, has a fixed barrel and a floating chamber in its Model 50. It also has an inertia rod that runs into the shoulder stock. When a shell is fired, the chamber moves back approximately $^{1}/_{10}$″, causing a special pin in the bolt to kick the inertia rod back against a spring in the shoulder stock. The hammer is cocked as the inertia rod moves rearward. At the extreme rearward position of the inertia rod, the bolt is opened and the shell is ejected. When the spent shell ejects, a new shell is allowed to enter the carrier. While the spring pushes the inertia rod forward the bolt moves forward, picking up the shell on the carrier and pushing it into the chamber. This ends the cycle and the shotgun is ready to fire.

In recent years, another method for powering semiautomatic shotguns is being used. Just like semiautomatic rifles, gas-operated semiautomatic shotguns are using the gas power from the exploding shell to operate the action. The gas is taken from a port in the barrel, and this action minimizes the amount of recoil the shooter has to withstand — making the gas-operated semiautomatic shotgun a very smooth operating gun and a pleasure to shoot.

Gas-operated shotguns include Beretta A-301, Browning B/2000, Franchi Model 500, Manufrance auto shotgun, Remington Model 1100, SKB autoloaders, Smith & Wesson Model 1000, Weatherby Centurion Auto, and Winchester's Models 1, 1400, and 1500.

Common Malfunctions

Malfunctions in autoloading shotguns may be caused by broken, damaged, or incorrectly assembled parts, faulty ammunition, incorrect operation, or debris in the mechanism. Since the receivers of autoloading shotguns are comparatively open, foreign matter can easily enter and clog the mechanisms. Therefore, a clean, properly lubricated gun inspected at frequent intervals is the best insurance against malfunctions and stoppages.

Malfunctions of autoloading shotguns sometimes occur from obscure conditions that would have no effect on a pump or other manually operated repeater. Most manufacturers put their guns through severe tests before leaving the factory to insure that the gun will function properly in the field. However, there may be potential trouble in some guns, undetectable at the factory, which will only come to light when used in the field under varying conditions.

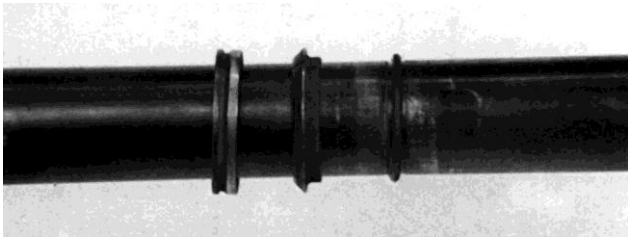


Figure 14-3: Proper arrangement of the gas-system components for the Remington Model 1100 shotgun.



Figure 14-4: The carrier latch is activated by the head of the shell as it leaves the magazine. A weak magazine spring will cause feeding problems.

The remaining causes of malfunctions can usually be traced to worn parts caused by excessive use and firing of the gun and, in some cases, mistreatment. For example, Franchi autoloading shotguns often develop feeding problems after several years of use. This problem can usually be traced to a worn carrier latch which is made of formed sheet steel, its edges turned to form flanges which contain the opposite holes for its pivot pin. Since this latch is under considerable repeated stress and the outside loop of the pivot holes is fairly thin, the holes will eventually begin to enlarge and finally the bridge of the loop will break, causing the gun to misfeed.

To correct this problem, raise a bead of steel weld at the pivot holes, leaving the walls of the latch thicker at that point, then redrill the holes to the proper size. Be sure to leave room for the latch spring. This extra thickness will give the additional strength necessary to eliminate future problems.

Another commonly worn part is on the Remington Model 1100 shotgun. This model utilizes a small ring of special rubber (Fig. 14-3) that fits into a groove on the magazine tube just forward of the piston and the piston seal ring. After many shots over a period of years, the rubber ring can become worn and lose some of its sealing qualities, causing a malfunction. Every gun shop should keep a few of these seals on hand at all times. They may be purchased from Remington Arms Company.

Autoloading shotguns also develop feeding problems from worn magazine springs. During the firing and feeding cycle, the carrier latch (Fig. 14-4) is activated by being struck by the head of the next unfired shell from the magazine. If the magazine spring is weak, the fed shell may have inadequate energy when propelled back against the latch and may fail to disengage it. The simplest way to correct this problem is to replace the magazine spring with a full-strength one. A temporary solution is to stretch the magazine spring or to adjust the carrier latch by bending it forward slightly.

The best way to troubleshoot these problems is to learn to recognize these worn parts when inspecting the group of parts where the problem is most likely to occur. When cleaning the gun, examine every part closely. Look for bright spots, rounded comers that should be sharp, out-of-round holes, and broken parts. Also check an exploded view of the gun to make certain that no parts are missing. This inspection alone should uncover any worn, missing, or broken parts. If none are found, chances are the malfunction was caused by dirt or debris in the action, which is already remedied since you have thoroughly cleaned the gun.

Troubleshooting Techniques

The autoloading guns covered in this section are generally similar in basic design, operation, and functioning. However, certain parts will naturally vary somewhat Malfunctions will therefore be covered generally as a guide only to be applied to the specific gun if and when applicable. The main concern is to learn how the guns function.

A malfunctioning gun should first be cleaned before inspecting the firearm or any repairs are made. This is especially true of any semiautomatic weapon.

In climates where the temperature and humidity are high or where salt air is present or during rainy seasons, the shotgun should be thoroughly inspected at frequent intervals and kept lightly oiled when not in use. In extreme climates the various groups of the shotgun should be disassembled for drying and oiling parts.

See that unexposed parts and surfaces are kept clean and oiled, such as the underside of the barrel, magazine tube, inner surface of the slide-handle tube, interior of the magazine tube, slide-handle bar, interior of receiver, operating parts, trigger group, spring wells, and similar parts and surfaces. Light oil should be used for lubricating.

All wood surfaces should also be inspected frequently to see that swelling due to moisture does not bind any working parts. If linseed oil is used on the gun stock, be careful not to let any of the oil seep into the working mechanism or it will gum the parts when it dries.

Failure to fire: As with other types of guns, when a semiautomatic shotgun fails to fire, the cause is most often gummy residue in the bolt which prevents the firing pin from moving forward the proper distance and/or at the proper speed. In shotguns using the short-recoil system, a light pull on the trigger can tip the sear against the second notch on the hammer, killing its inertia. An improper adjustment between the hammer catch and hammer can also cause misfires.

Firing pin length is especially critical in an autoloader, and at the first sign of a misfire, the bolt assembly should be disassembled and thoroughly cleaned and inspected. If the pin is impeded in its travel to the rear for any reason, the gun can fire automatically, slamming the bolt back and forth until the magazine is empty.

A broken firing pin or firing-pin spring should be obvious upon inspecting the disassembled bolt assembly. If at all possible, replace these with new factory replacements. If this is not practical, new ones can be made or the broken one can be repaired by welding, but use extreme caution to obtain the original dimensions. To insure that the firing pin is not too long, tape a piece of electrical tape over the primer hole of a *fired shell*. Insert this empty shell with the tape into the chamber and let the bolt assembly slam home as if operating during actual firing. If the piece of tape is indented at all, the firing pin is too long and must be shortened.

Bolt fails to close fully: This problem can be caused by a lack of lubricant on mating surfaces, but more than likely the fault lies with burrs or foreign matter in the locking recesses in the receiver raceways. Stone all burrs and sharp edges on the hammerhead contacting link and check for sharp comers on the rear of the chamber. Should the chamber rotate slightly, the slides can hang up on the sharp edges.



Figure 14-5: Expanding dent plug used to remove dents from magazine tubes and shotgun barrels.

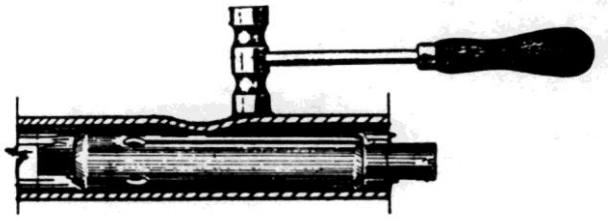


Figure 14-6: Expand the dent plug until it fits tightly under the dent, and then use a brass hammer to tap around the edge of the dent to raise the metal.

Sometimes a broken, rusted, or improperly engaged recoil spring can cause the action not to lock up properly, as can a damaged carrier or carrier latch. All of these faults should be readily apparent.

When the reason for a bolt's failure to close fully is not readily apparent, remove the appropriate groups from the gun, then clean, inspect, and test them (in that order). Old shells may be the cause of the problem, so don't overlook this. Also inspect the shell seat in the barrel.

Failure to feed: The problem of improper feeding in autoloading shotguns will probably be the one most often encountered... or at least this has been my experience. In general, feeding problems are due to either a faulty magazine (and components), a faulty carrier, malfunction of shell stop(s), or a dirty action — preventing the appropriate parts from functioning correctly. Of course, if the fired shell fails to eject, a new shell cannot be fed into the chamber and feeding is again a problem.

Magazine tubes under the barrel of a shotgun are located in an ideal place to get banged against all sorts of objects. When dents, gashes, and bends occur, feeding problems almost always arise from binding of the magazine spring to crimping the shells within the tube. In most cases, dented magazine tubes can be repaired by inserting an expanding dent plug (Fig. 14-5). They should be made of bronze to prevent jamming or marring the surfaces. Expand the dent plug until it fits tightly under the dent and then use a brass hammer to tap around the edge of the dent to force the dented metal up (Fig. 14-6). Keep hammering until the dent is up or the plug comes loose. If the plug comes loose before the dent is up, repeat the process of expanding the dent plug, pushing it under the dent and hammering around the edge until the dent is completely up. This same procedure may also be used to remove dents from shotgun barrels.

All autoloading shotguns use two shell stops positioned on each side of the receiver wall. The primary shell stop delays the shell at the mouth of the magazine until the lifter or carrier accepts it. The second shell stop holds back the other shell while the first shell is being lifted by the carrier. Once the first shell is chambered, the second shell stop releases the next shell, which is then held in position by the first shell stop. Should this second shell stop miss or release too soon, the shell in the magazine ends up on the ground. On some guns, this can be caused by the carrier lock head being too low thus allowing the rim of the shell to pass through the cutoff. Of course, the problem may be solved by installing a new carrier lock, but usually the repair can be made by inserting the carrier lock in a vise with the button and head protruding and then striking the button lightly with a hammer to bend the carrier lock in slightly. Assemble and check your work carefully to see that the shell head does not pass through the carrier lock. Finish up by feeding a shell from the magazine tube and adjusting the carrier lock. To do so, remove the trigger guard and slide a shell in and out of the magazine tube. If the front end of the carrier lock scrapes the shell, it should be stoned until it just clears the shell case.

The second shell stop seldom gives trouble except for occasionally burring at the edges after heavy use over a period of years. This problem can normally be dressed out by stoning.

Shell lifters are another source of trouble when feeding is a problem. If a shell lifter is badly worn or bent, it will not fully lift the shell and a replacement is about all that can be done to remedy the situation.

Defective safeties: Most autoloading shotguns employ trigger block safeties which utilize a spring-loaded plunger that works in two notches. When the safety button is pushed from safe to fire, the plunger is depressed and rides over a hill that separates the two notches. This hill, after years of use, can become rounded and can then slip easily from one notch to the other, rendering the safety feature worthless. Sometimes the safety can be corrected by grinding the notches deeper, but a replacement of this, critical device is recommended. Also if the plunger or its spring become worn, replacement must be made.

Miscellaneous malfunctions: The problems of extracting, ejecting, rough trigger pulls, etc. are essentially the same for autoloading shotguns as for other types of shotguns and rifles, so there is no need to mention them again under this chapter. The troubleshooting chart in Fig. 14-7, however, summarizes the most common malfunctions characteristic to autoloading shotguns along with their remedies. A study of this chart will give you a starting place when troubleshooting semiautomatic guns. Again, to be able to adequately troubleshoot any firearm, you must first understand how it functions, and exactly how each part is used to make the gun work properly.

TROUBLESHOOTING CHART
Semiautomatic shotguns

Malfunction	**Probable Cause**	**Corrective Action**
Fails to extract	Faulty extractor	Replace
	Extractor slot loose on shell rim	File or replace
	Extractor slot in barrel damaged	File slot to proper fitting of extractor
	Extractor spring defective	Replace
	Rough chamber	Repolish chamber

Figure 14-7: Troubleshooting chart for semiautomatic shotguns.

Malfunction	Probable Cause	Corrective Action
Fails to Fire	Damaged firing pin	Replace
	Connector not seating to sear	Clean assembly or replace sear or connector
	Disconnector binds connector	Free up or replace
	Hammer fails to cock	Refit hammer and sear notch
	Trigger binds	Free up trigger or replace
Fails to feed	Carrier latch defective	Replace
	Carrier release defective	Replace or adjust
	Carrier jams	Adjust shell latch
	Tight extractor	Replace extractor or hone claw to ease tension
	Shell latch doesn’t slip off shell properly	Adjust shell latch
	Shell latch stop surface rough	Hone notch or replace
	Carrier lays too high	Adjust or replace
	Magazine spring damaged	Replace
	Magazine double feeds	Replace shell latch
	Dented magazine tube	Remove dents
Fails to load	Follower latch defective	Replace
	Follower latch drops too far in magazine tube	Replace
	Rough follower latch slot	Deburr or hone smooth
	Magazine follower, spring, or tube defective	Replace
	Carrier release fails to release carrier latch	Replace or adjust
	Carrier latch jams carrier release	Replace carrier latch or spring
Fails to close	Crooked action bar	Straighten or replace
	Carrier movement defective	Replace carrier
	Action spring defective	Replace
	Piston assembly defective	Clear
	Action bar stud defective	Replace action bar assembly or repair damage
Fails to lock open	Incorrect head space	Adjust head space
	Locking block binds	Free up
	Action binds	Free up
	Rough barrel chamber	Polish chamber
	Damaged extractor or extractor slot	Replace extractor or repair slot

Figure 14-7: Troubleshooting chart for semiautomatic shotguns (Continued).

Chapter 15 - Troubleshooting Revolvers

The revolver is perhaps the oldest form of repeating firearm. Wheel-lock ignition revolvers were in use as early as the 15th century, but the first true working revolver is generally credited to Samuel Colt.

Traditionally, the handgun has been a weapon of self-defense. In recent years, however, it has been used extensively for big game hunting, target shooting and, even more recently, metallic silhouette competition. Modern cartridge handguns are manufactured in singleshot, revolver, and semiautomatic types; the revolver is either single- or double-action in operation. Both recoil- and gas-operated semiautomatic pistols are in use.

This chapter is designed to give you a working knowledge of handgun operation and how to put handguns back in working order when they malfunction. You will also learn some useful customizing techniques to improve smoothness of operation and to help make the handguns more accurate and more comfortable to shoot. Special tools required for handgun repairs are fully covered, along with some you can make in your own shop.



Figure 15-1: Many operating characteristics of modern Colt revolvers were first introduced about 1898. The same basic design is still in use today.

Colt Handguns

The following information will apply directly to Colt revolvers with a design first used about 1898 and includes: Officer's Model, Official Police, Police Positive Special, Police Positive, Detective Special, Banker's Special, New Service, Police Positive and Shooting Master, and the Model S. Of course, this information will also be valid, in part, to other Colt models, which should be readily apparent as you become more familiar with Colt designs.

Disassembly: Remove crane-lock screw and crane lock. Press back on latch, push cylinder to the left and remove cylinder and crane assembly to the front. Remove grip stocks — being careful not to chip them in the process.

Remove sideplate screws and sideplate before removing latch and spring from sideplate. The mainspring may be removed by lifting the rear end from its seat and disengaging the long end from the hammer stirrup. Remove the hand.

Drive out the rebound-lever pin to the right, and remove rebound lever. Remove trigger. Draw hammer to the rear and lift from the hammer pin. Remove safety lever and safety from its seat in frame. Remove latch bolt.

The cylinder may be further disassembled by first unscrewing the ratchet and ejector-rod head from the ejector rod. Remove the crane bushing with special wrench from crane. Remove ejector rod and spring.

Function: As the hammer of these revolvers are pulled to the rear, the hammer engages the trigger pulling it rearward at the same time; the hand attached to the trigger also rises during this operation. This hand, acting on the rebound lever, causes the rebound lever to release the "locked" cylinder. The hand further engages the ejector notches in the cylinder and causes the cylinder to rotate. The lever attached to the Digger pulls the safety from between the frame and hammer. The bolt is then released and allowed to engage the cylinder lock.

Malfunctions: The rebound lever and the cylinder bolt are subject to wear and will often have to be replaced after much use. New factory parts, when available, usually have to be hand fitted. Both new and used parts are also obtainable from gun part suppliers such Jack First Distributors, Inc., 44633 N. Sierra Hwy., Lancaster, CA 93534. The latch and latch pin are also subject to wear.

Although rare, the crane and frame sometimes become bent. Broken mainsprings do occur occasionally.

Another common malfunction is during rapid double-action firing; the cylinder will "skip," which usually requires the installation of a new bolt spring.

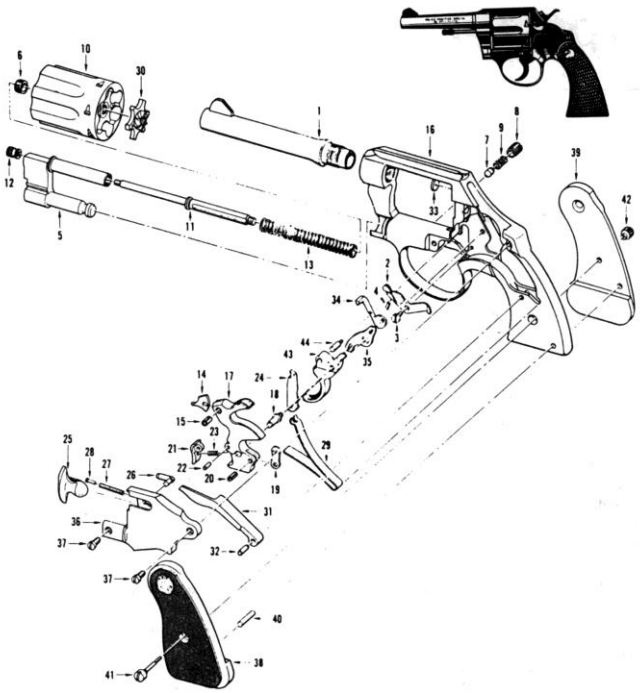


Fig. 17-1: Exploded view of Colt's Police Positive Revolver.

Parts List

Key No.	Description	Key No.	Description	Key No.	Description	Key No.	Description
1	Barrel	11	Eje't Rod	21	Strut	31	Rebound Lever
2	Bolt	12	Rod Head	22	Strut Pin	32	Lever Pin
3	Bolt Screw	13	Eject. Sprg.	23	Strut Sprg	33	Recoil Plate
4	Bolt Sprg.	14	Fir’g Pin	24	Hand Det.	34	Safety
5	Crane	15	Roll Pin	25	Latch	35	S Lever
6	Crane Bush'g	16	Frame	26	Latch Pin	36	Side Plate
7	Crane Detent	17	Hammer	27	Spring	37	Plate Screws
8	Screw	18	Hammer Pin	28	Guide Sprg	38	Stock. L.
9	Crane Lock Sprg.	19	Stirrup	29	Mainsprg.	39	Stock. R
10	Cylinder	20	Stirrup Pin	30	Ratchet	40	Stock Pin

Figure 15-2: Exploded view and parts list for a Colt Police Positive revolver. This will assist you with identifying parts during disassembly and for ordering replacement parts.

Basic Tools for Colt Repairs: For more than just minor maintenance on Colt revolvers, the following tools are recommended:

- Ratchet wrench
- Crane bushing wrench, mainspring clamp, or long-nose pliers
- Screwdriver
- Rawhide or plastic mallet
- Peening hammer
- Side-cutting pliers
- Assorted Swiss files
- Honing stone
- Bolt screw counterbore or drill
- Prick punch
- Drift punches
- ⅛″ brass drift punch
- Bolt spring pusher
- Fine emery cloth
- Headspace gauge
- Feeler gauge
- Firing pin protrusion gauge

Inspection and Repair: To check any of the Colt models listed above, loosen the sideplate screws along with the crane and latch drop. Then use the headspace and feeler gauges to check the headspace. Check end-to-end cylinder play; check for loose barrel and barrel joint. Continue checking for worn or loose trigger and hammer pins; also for loose bolts or screws.

During some inspections you will find where the safety has been damaged or purposely filed; trigger sears will be worn or short; firing pin or hammer notch defective; strut out of position, or wrong shape or length; weak mainspring; worn rebound-lever cam; bolt and rebound lever out of time; worn hand, or hand out of time.

Dimensions & Tolerances	
Headspace	·060 - ·065″
Trigger pull	3 - 4 lbs.
Barrel joint	·002 - ·004″
Firing-pin protrusion	·040 - ·050″

Firing Pins: Measure firing pin protrusion with a gauge by the same name (available from Brownells, Inc). To use, with hammer fully forward, place the gauge over the protruding firing pin and against the revolver's recoil plate. Lock the gauge's plunger and lift from the firing pin. Use a micrometer to measure the overall length of the gauge; the difference between the original length (·5000″) and measured overall length of the body, plus plunger, is the amount of firing-pin protrusion. Correct protrusion should be between ·040″ to ·050″.

Long firing pins may be filed shorter, but short firing pins should be replaced. In some cases, the firing pin may be built up by welding and then rehardened, but this is not recommended standard practice.

Floating firing pins should not have too little or too much up-and-down travel so as not to damage the recoil plate. When the firing pin protrudes through the recoil plate, a small amount of "play" should be noted, but not too much. The back side of the firing pin may be filed to correct the up-and-down movement; file the top for higher travel, and the lower portion for lower travel as shown in Fig. 15-3.

When replacing a firing pin, the rivet hole in the hammer should be countersunk slightly and a new rivet used. Peen both ends of the rivet and then file them flush with the hammer surfaces.

Safety Levers: The safety lever should work freely at the hammer-pin boss. The safety and trigger pins must work freely in the safety lever slots as shown in Fig. 15-4.

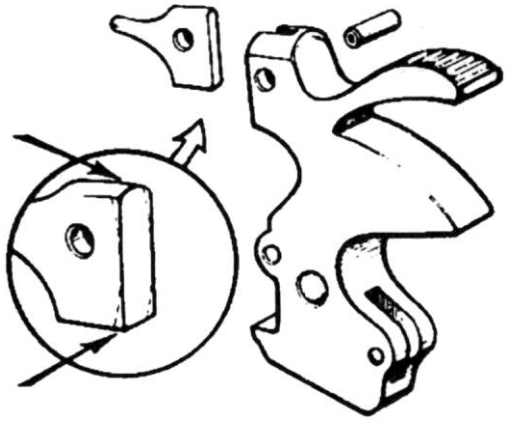


Figure 15-3: Areas to file firing pin to correct up-and-down movement.

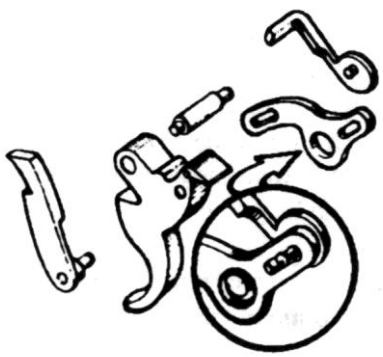


Figure 15-4: Safety and trigger pins must work freely in safety-lever slots.

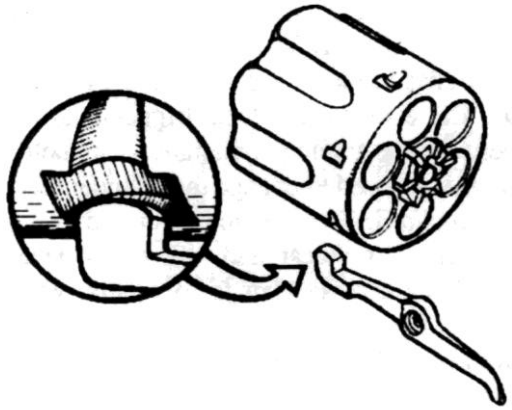


Figure 15-5: Top of bolt head should match contour of bolt leads.

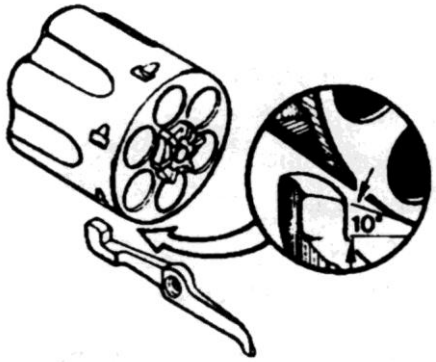


Figure 15-6: The bolt head should fit freely into the bolt cuts in the cylinder.

Bolt: The top of the bolt head should match the contour of the bolt leads in the cylinder as shown in Fig. 15-5. The head of the bolt should be beveled approximately 10 degrees to match the contour of the cylinder with the lower side of the head contact riding point as shown in Fig. 15-6. The bolt head should fit into the bolt cuts in the cylinder freely, but with as little tolerance as possible. Bolts that are worn loose should be replaced.

Figure 15-7 shows the correct place to file the bolt for correctly fitting to the cuts in the cylinder. The bolt screw must be seated tightly to the frame with a slight drag noted when moving the bolt without the bolt spring in place. If the bolt is too tight, file the underside of the bolt — at the screw hole — until the bolt works properly. If the bolt is too loose, the bolt-screw hole in the frame should be counterbored slightly until a slight drag is noted. Either a $^{3}/_{16}$″ or $^{1}/_{4}$″ drill may be used for this operation.

When the bolt cut in the frame is worn, allowing side play in the bolt head, the cut should be peened to eliminate any excessive play. The bolt spring should be strong enough for the bolt to snap sharply into the cylinder-bolt cuts, and yet allow the top of the bolt head to travel so it is at least flush with the bolt cut in the frame. The bolt head should enter the cylinder-bolt cuts approximately $^{1}/_{32}$″.

If the bolt head is short the cylinder will not lock. Correct this fit by filing the bolt at point E as shown in Fig. 15-7. If the bolt head is too long, it will not allow the bolt to clear the cylinder when cocking. Correct this by filing the bolt as shown at “D” in Fig. 15-4 and “C” in Fig. 15-5. Finally, polish the bolt head with fine emery cloth or similar abrasive. See Fig. 15-8 for the proper shape of the bolt tang.

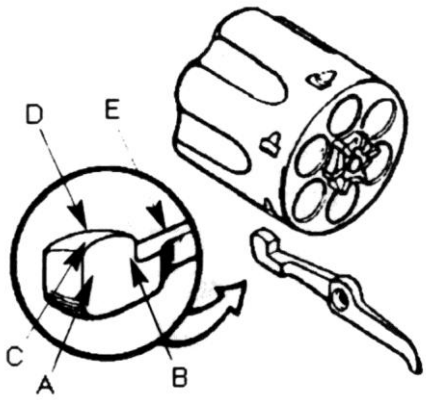


Figure 15-7: Points to file bolt head for correct fitting.

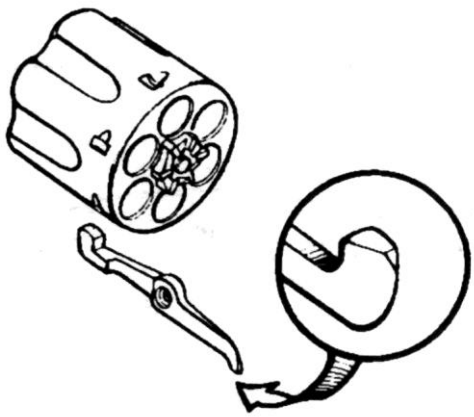


Figure 15-8: The proper shape of the bolt tang when polishing or shaping.

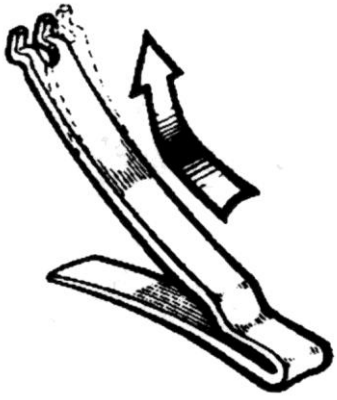


Figure 15-9: A weak or stiff mainspring can usually be corrected by slightly bending it near the center of the arm.

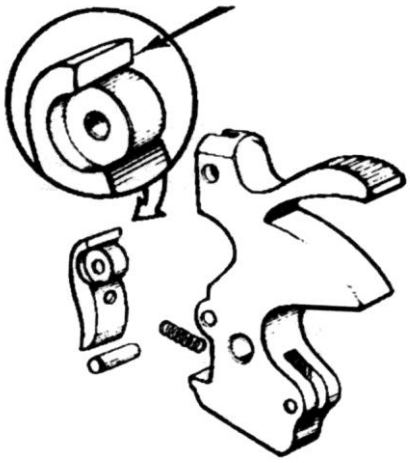


Figure 15-10: The strut should be sharp and smooth, but never blunt.

Mainspring: A weak mainspring will cause misfires and poor rebound in any revolver action. A stiff spring increases single- and double-action pull, so a property "tuned" mainspring has a lot to do with good accuracy.

In some cases, a weak mainspring may be corrected by bending the upper arm at its center. A stiff mainspring may be loosened up some by inserting a small drift pin between the spring arms and then cocking the revolver. See Fig. 15-9.

Strut: The strut should be long, and away from the hammer as much as possible without interfering with the sear end of the trigger during its exit from the hammer notch. The stmt should be sharp and smooth — never blunt. To achieve this condition, file the stmt as shown in Fig. 15-10.

If the strut is out too far it may be bent at the center. Set or peen holes in the hammer to prevent the pin from coming out. Note that a short stmt will cause the hammer to fall before the cylinder has indexed with the barrel when using double-action; this will also cause a light hammer blow — both resulting in misfires.

Safety: The revolver's safety should work freely in its safety cut without excess play. To remove excessive play, slightly bend ball of the safety. This may also be filed somewhat when it is tight, but never reduce the dimensions of that part of the safety bar that blocks the hammer; this could be dangerous. See Fig. 15-11.

Hammer and Trigger Pins: Both of these pins are drive-fit pins and should be replaced when loose. Drift out pins with a brass drift punch and hammer. In an emergency situation, temporary repairs may be made by reversing the pins. However, try to use new pins if at all possible.

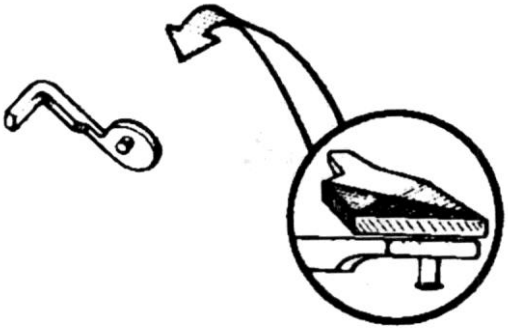


Figure 15-11: In fitting the safety bar to the revolver, never reduce the dimensions of the part that blocks the hammer. The remaining portion, however, can be filed to the proper fit.

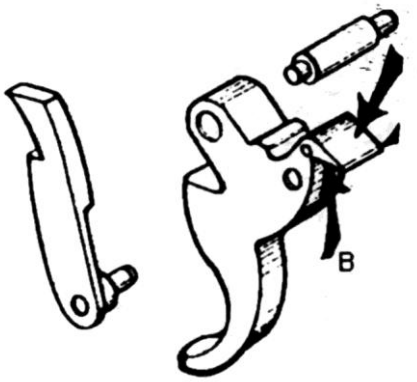


Figure 15-12: The points on the sear that will determine the weight and feel of the trigger pull.



Figure 15-13: Reducing the depth of the hammer notch with a honing stone at the points indicated by the arrows lightens the trigger pull.

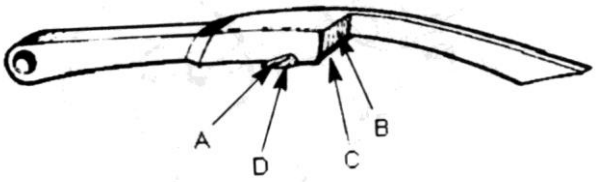


Figure 15-14: The filing or honing points on the rebound lever.

Trigger and Hammer: The proper angle and thickness of the sear end of the trigger determines the "feel" and weight of the single action trigger pull. See Fig. 15-12.

A blunt trigger sear will cause creep whereas too sharp an angle will cause poor cocking action and a heavy trigger pull. When the pull is too light, the sear end may be thinned by filing on the underside of the sear as shown at point "B" in Fig. 15-12. When the pull is too heavy, reduce the depth of the hammer notch by honing as shown in Fig. 15-13. In either case, always polish both the top and underside of the sear with fine emery to maintain a smooth cocking action.

If the hammer can be pushed off with the thumb, when the revolver is in the cocked position, the trigger is obviously too light and very dangerous. The pull for most revolvers should be between 3 and 4 pounds, and the sear, along with the hammer notch, play the most important role in determining the weight of trigger pull.

An excessive amount of play between the back of the hammer and the revolver frame indicates that the sear end of the trigger is too short and needs replacing. When this condition exists, the revolver cannot be timed correctly. When any of the above operations are performed, the indexing of the cylinder must be checked to ensure proper functioning.

Rebound Lever: The cam of the rebound lever determines proper lifting and dropping action of the bolt. The lever must return to its position low enough to enable it to pick up the bolt tang. See "A" in Fig. 15-14. The cam may be lowered by bending the rebound lever at the center, filing the front flat lever part of the rebound, or by filing the underside of the front angle. There should be no tolerance between the cam and bolt tang, otherwise the bolt will not clear the cylinder.

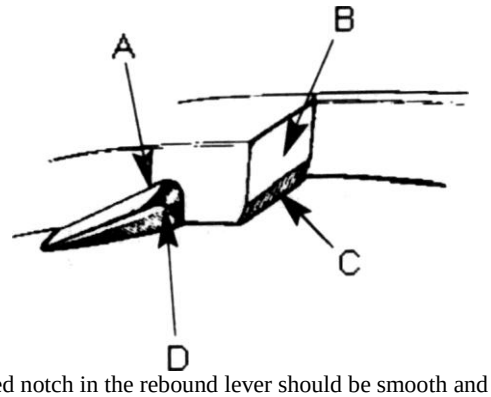


Figure 15-15: The triangular-shaped notch in the rebound lever should be smooth and slightly rounded at its outer edge.

In all cases, the bolt should respond immediately when the hammer or trigger are moved. Any tolerance can be removed by bending the rebound lever up at its center, but this may cause the safety to catch under the hammer when it is rebounding. If so, replacement of the lever is in order.

The top point of the cam should be straight and slightly rounded as shown at point "A" in Fig. 15-15. The triangular-shaped notch should be smooth and rounded at the outer edge (point "D").

The bolt tang should not drop lower than $^{1}/_{3}$ the narrow part of the bolt lead in the cylinder. Otherwise, the bolt will not drop in time to lock the cylinder during rapid fire. To drop the bolt earlier, shorten the cam by filing the front triangular-shaped notch. If the bolt drops too early, the rebound lever should be replaced.

Sometimes the trigger will not clear the strut when rebounding. This condition may be corrected by filing the front flat of the lever ("C" in Fig. 15-15) as long as the safety will clear the hammer. When the safety catches on the hammer, the front flat is too short requiring that the rebound lever be replaced.

To test for a "bouncing hammer," bring the hammer to full cock then push forward on the hammer with the thumb. If the hammer bounces in the frame, file the comer of the front flat at point "C" as shown in Fig. 15-15 until any bounce is relieved.

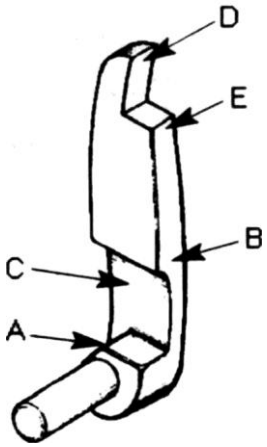


Figure 15-16: Points of fitting on the hand.

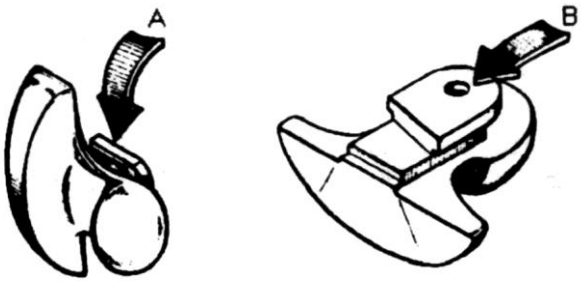


Figure15-17: Points to correct latch problems by either(A) peening or (B) filing.

Hand: Spring tension of the hand is determined by the rebound lever fit on the cam of the hand. When no tension is noted, file the rear angle of the cam to increase the angle. See Fig. 15-16. If, during operation, the hand misses the ratchet on the cylinder, file the front center portion of the hand (point "B") to let hand protrude farther. Furthermore, the hand must be free in the frame and as close to the frame as possible. To obtain this condition, the hand may be bent at its center.

When the cylinder does not rotate far enough to properly index, the hand is probably too short. Stretch the hand by peening with the chisel end of a cross-peen hammer at point "C." When the lower portion of the hand is too long, the cylinder will index before the trigger engages in the hammer notch. The indexing should be made uniform by filing the particular ratchet lug.

When the bolt head does not clear the cylinder, and the bolt and rebound lever are adjusted correctly, the top finger of the hand may be filed slightly to delay rotation of the cylinder. If the top finger is too short, the cylinder will bind between chambers. If this condition exists only when the gun is loaded — and you are sure that headspace is correct — the top or bottom finger lever may be interfering with the cartridge casings. Use one "dummy" or empty cartridge case to check the position of the chamber when the bind occurs. The front of the top finger may have to be filed back or else the top front edges rounded; that is, point "D" in the illustration. Should the bottom finger be at fault, reduce the depth at point "E" on the bottom finger.

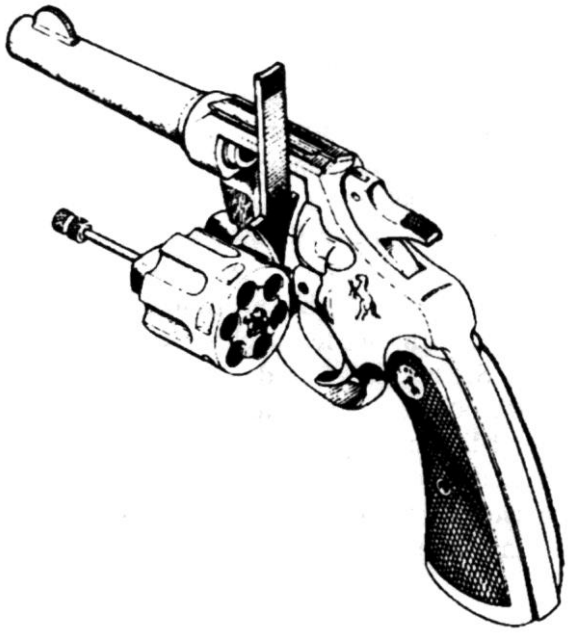


Figure 15-18: Method of correcting a crane that is sprung outward.

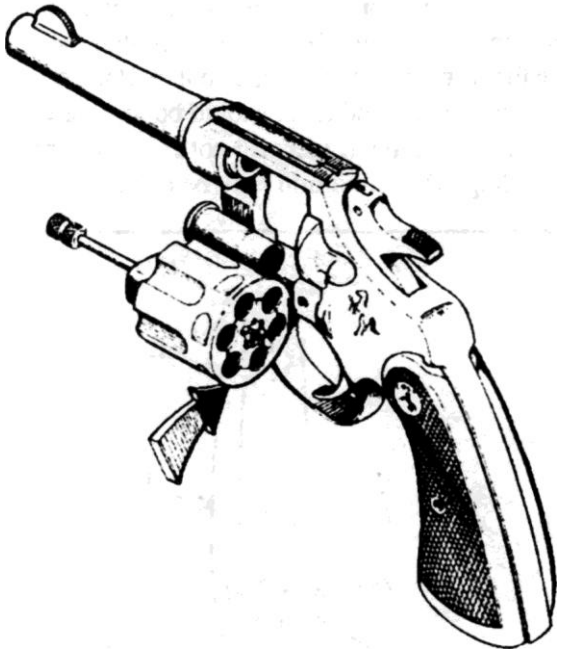


Figure 15-19: Method of springing a cylinder inward.

Latch: The latch pin should work freely in the frame. Weak latch springs should be replaced and the spring hole in the sideplate can be reamed if the spring fits too tightly. Any excess side play in the latch can be removed by peening the underside of the latch cut in the sideplate. Repair any up-and-down looseness by peening the latch guide ribs down in the direction of the latch. See "A" in Fig. 15-17. Should the latch bind, it may help to file the underside of the latch at point "B" in Fig. 15-17.

Crane: A latch that works freely, but does not lock properly when the cylinder is closed, is an indication that the crane is either loose or sprung. This condition can usually be corrected by slightly bending the crane. To determine the direction to bend the crane, press in, up or down on the cylinder until the latch drops in place; bend the crane accordingly.

With the cylinder closed and the latch in place, an excessive amount of play between the front of the crane and frame is an indication that the cylinder and crane must be sprung outward. To correct this condition, open the crane fully and then tap sharply, outward from the frame, with a rawhide or plastic mallet until the play between the crane and frame is corrected, but still allows the latch to drop. See Fig. 15-18.

When the cylinder has to be sprung inward, place an empty cartridge case between the frame and crane; then tap the cylinder inward towards the frame as shown in Fig. 15-19.

If the condition dictates that the cylinder must go up, first open the crane fully; then use the wooden handle of a mallet to tap the cylinder from the right side; use the cylinder opening in the frame as access to the cylinder. See Fig. 15-20.

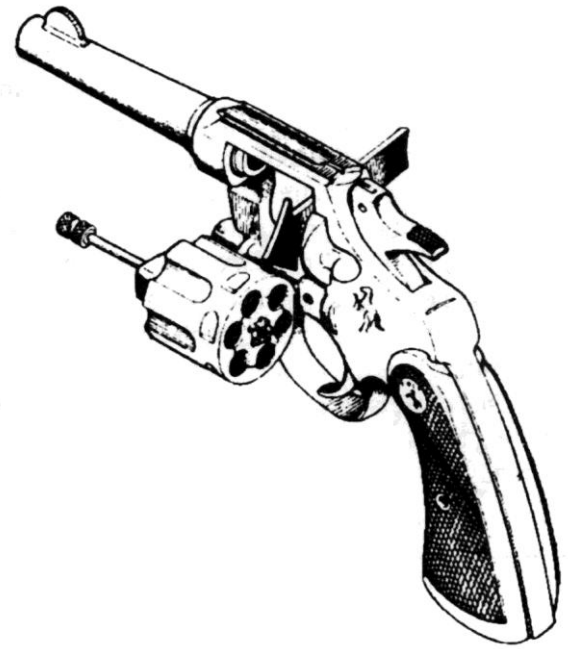


Figure 15-20: Method used to spring a cylinder upward.

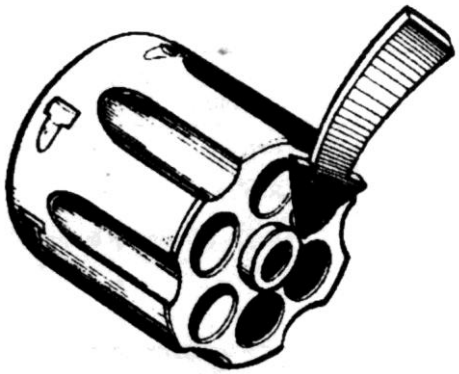


Figure 15-21: Headspace can be corrected by changing the length of the collar.

Cylinders that must be sprung downward require the removal of the crane from the frame. Place the cylinder on a work bench, with the crane directly above the cylinder. Then tap the crane downward towards the cylinder with a rawhide or plastic mallet as shown in Fig. 15-20.

Cylinder, Ratchet and Ejector Rod: Headspace for Colt Official Police revolvers should be between ·060 and ·065″ Headspace must be checked with the cylinder pressed forward. Tight headspace may be corrected by reducing the length of the cylinder collar as shown in Fig. 15-21. Conversely, excessive headspace may be corrected by stretching the cylinder collar. However, many times on the older models, after this headspace correction has been made, there will be excessive end-to-end play in the cylinder. If this condition occurs, the ratchet must be replaced. Because of this, the headspace should always be corrected before fitting a new ratchet If this new ratchet offers problems, such as difficulty in closing the cylinder, file the ratchet evenly until the cylinder closes freely with no end play. It is sometimes recommended to slightly peen-punch the ratchet and end of the ejector rod to keep them from coming loose.

The end of the ejector spring should be crimped so as not to jump the collar of the ejector rod. The ejector rod sometimes becomes bent during operation and also during repair jobs; if so, merely remove it and straighten.



Figure 15-22: Equipment needed for removing revolver barrels.

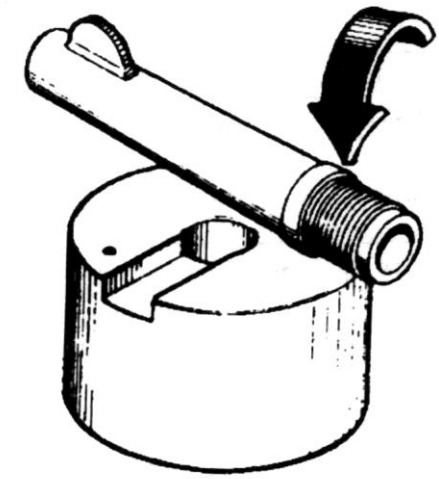


Figure 15-23: Loose barrels can be temporarily corrected by peening down the barrel shoulder.

Barrel: The barrel joint between the breech and front of cylinder should be spaced between ·002 - ·008″ The barrel should have a moderate throat at the breech. If the throat is too small the revolver may “spit lead,” shaving off a portion of each bullet as it is fired. On the other hand, if the throat is too large, the bullets may “keyhole” upon firing.

Most revolver barrels can be removed by making a set of wooden blocks as shown in Fig. 15-22 which are used to tightly secure the barrel in a vise. Powdered rosin is used on the barrel to keep it from turning when pressure is applied to the frame. With the barrel tightly secured, and the crane and cylinder removed, insert a wooden member through the cylinder opening in the frame and twist frame counterclockwise to remove; clockwise to tighten.

To correct a loose barrel or open barrel joint, the shoulder of the barrel should be turned on a lathe — enough to allow the barrel to be screwed in one more thread. The barrel, of course, must then be re-jointed to form the proper gap between it and the cylinder. During an emergency situation, a loose barrel may be corrected by removing the barrel from the frame; then peen down the shoulder of the barrel before refitting as shown in Fig. 15-23.

If care is taken, a relatively even peen can be obtained just by using a ballpeen hammer and a wooden block. With the barrel removed from the frame, hold the barrel by the muzzle end and with the threaded end resting on the wood block, lightly peen the shoulder of the barrel as it is slowly revolved on the block. Go slow and don’t overdo it; it’s easier to peen more than to swage the metal back in place if you peen too much.

An even simpler method is to use a tubing cutter with the round cutting blade removed; a roller bearing is then installed in its place. With the barrel secured in a padded vise, rotate the tool on the barrel shoulders, tightening down the pressure screw on the tool after each complete revolution. Apply only slight pressure with each revolution, otherwise the tool may be damaged.

The troubleshooting chart below covers most problems that will develop with Colt revolvers. It is also valid for the Smith & Wesson revolvers that follow in the next section. This chart is meant as a quick-reference source for spotting problems, along with the normal corrective action required.

TROUBLESHOOTING CHART Colt Revolvers		
Malfunction	**Probable Cause**	**Corrective Action**
Misfires	Excessive head space	Repair
	Insufficient firing-pin protrusion	Replace pin
	Weak mainspring	Replace
Hard extraction	Rough or very dirty chambers	Clean and polish
Hard cylinder rotation when gun is empty	Bent crane	Straighten or replace
	Insufficient barrel/cylinder gap	File larger gap
	Rough or burred recoil shield	Polish smooth
Trigger won't return after firing	Broken trigger return or rebound spring or lever	Replace
Hammer won't cock	Broken trigger nose or hammer	Replace
Hammer won't come all way back	Burrs or parts interference inside	Inspect and repair or replace parts
Hammer won't stay cocked	Chipped or worn sear notch	Recut notch or replace hammer
Crane won't open	Bent or broken crane lock	Replace
	Bent crane	Replace
	Primer extruded into firing pin hole	Replace firing-pin bushing

Figure 15-24: Troubleshooting chart for Colt revolvers.

Smith & Wesson Revolvers

Smith & Wesson revolvers that were manufactured within the last 50 years or so all function approximately in the same way. As the hammer is pulled to the rear it cams the trigger back against the compressed rebound lever spring, and at the same time the cylinder bolt is disengaged from the cylinder notch. The hand attached to the digger is pushed upward, rotating the cylinder. When the hammer is approximately half-way back, the cylinder bolt is disengaged by the trigger, the force of the cylinder-bolt spring then forces the cylinder bolt against the cylinder. When the cylinder chamber is in line with the barrel, the cylinder bolt engages in the cylinder notch, locking the cylinder in place for firing. The sear on the trigger engages the hammer, holding it in its cocked position — ready for firing. This basic operation is valid for most S&W revolvers.

When the trigger is released by being pulled or squeezed, the hammer and trigger are disengaged, allowing the hammer to fall upon the firing pin. As the trigger is released, force of the compressed rebound lever spring forces the rebound lever forward. A lug on the rebound lever engages the hammer, camming the hammer back enough to withdraw the firing pin, and at the same time, forces the trigger to return to its normal position.

When a Smith & Wesson revolver is fired double action, the sear end of the trigger engages the strut which cams back the hammer. All other operations are the same as described previously.

Fitter's Block

Besides the tools listed earlier in this chapter for the repair of Colt revolvers, a part-fitter's block as shown in Fig. 15-25 is recommended. The drawings and dimensions given should enable anyone experienced in machine shop techniques to easily turn such a block on the metal-turning lathe, or if 2½″ stock is available, merely cut off a two-inch piece and use a drill press and files to finish the block according to the drawings in Fig.15-25. It may take a little time without machine tools, but if much revolver work is anticipated, this little block can save much time. If you don't want to go to the trouble of making the block yourself, you may purchase a ready-made S&W block from Brownells Inc., but they are not cheap.

Troubleshooting

An exploded view of a Smith & Wesson revolver is shown in Fig. 15-26, along with a list of parts. This drawing and parts list should be referred to frequently until all part names in the following paragraphs are well known.

One of the most common problems found in some of the older Smith & Wesson revolvers is loosening of the ejector-rod head during firing. When this head is loose, the ejector rod is lengthened which causes the cylinder to bind; sometimes to the extent that the cylinder cannot be rotated or opened — a problem that must be corrected if the revolver is to be used.

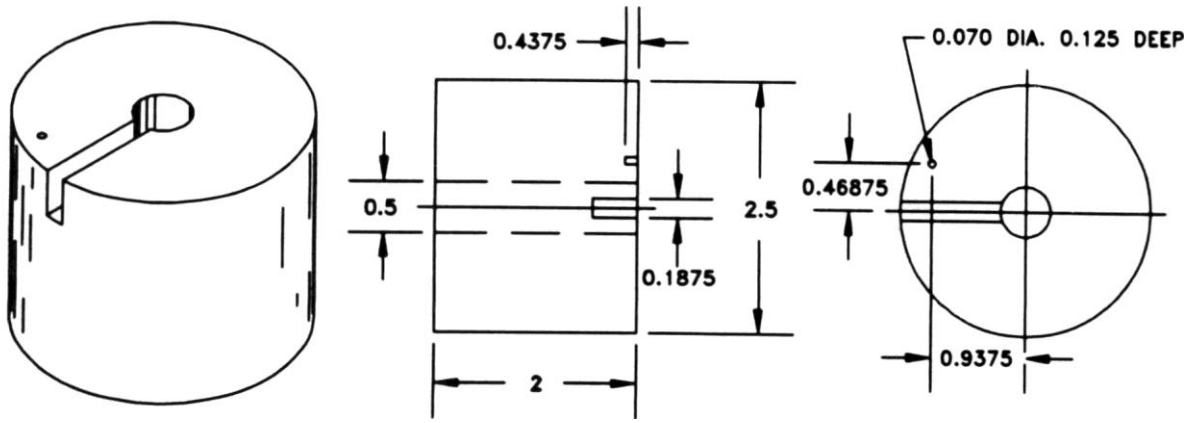


Figure 15-25: Dimensions for Smith & Wesson part-fitter's block. This block can be purchased from Brownells, Inc.

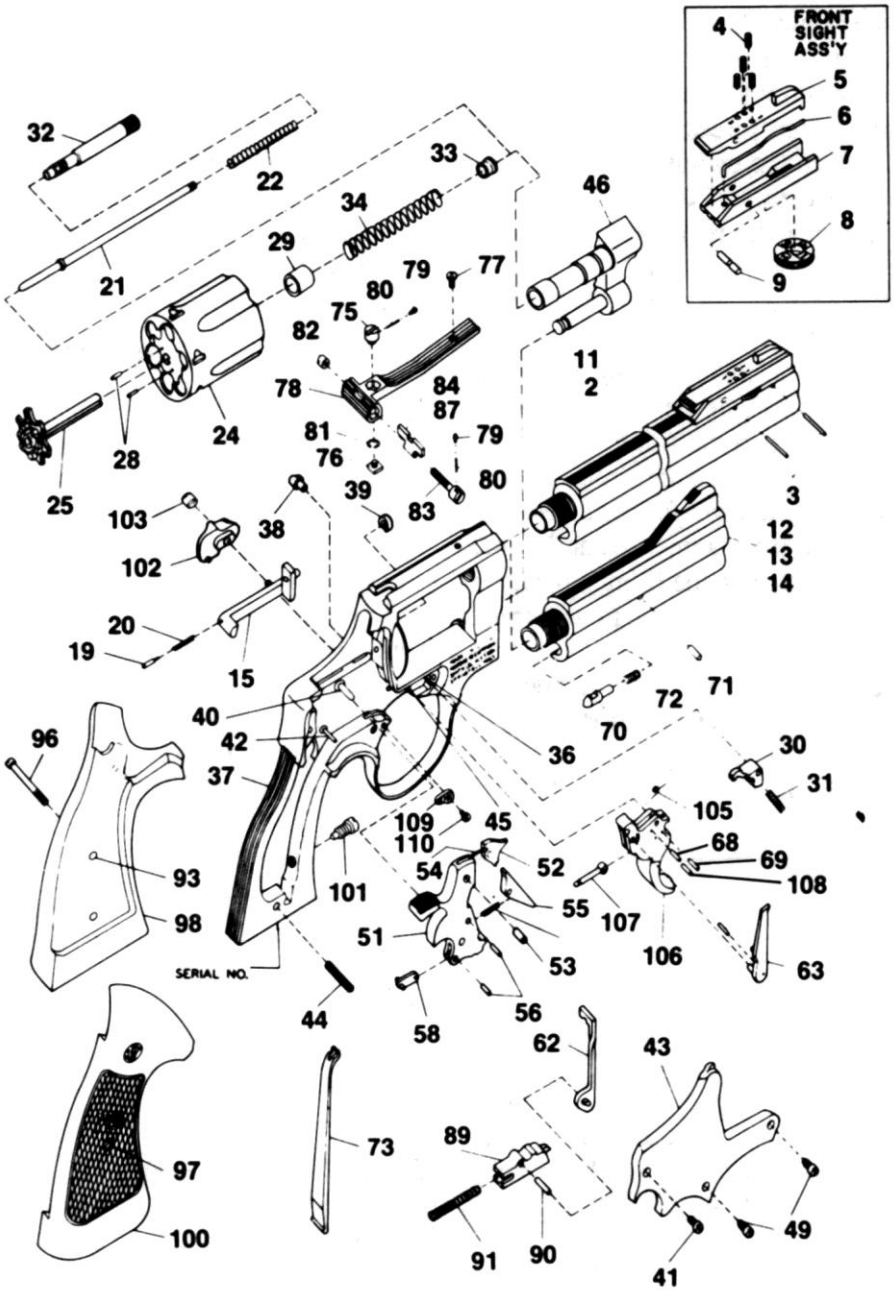


Figure 15-26: Exploded view of a Smith & Wesson revolver.

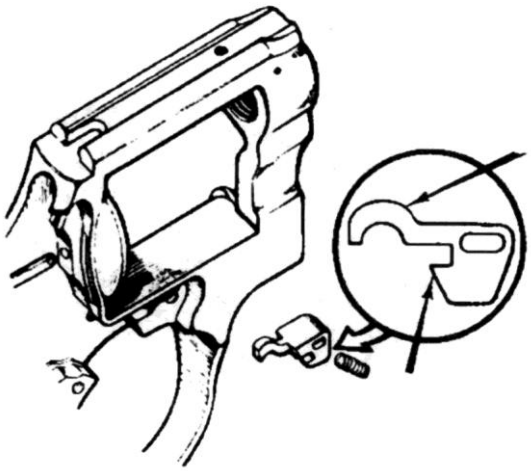


Figure 15-27: Points on S&W revolver cylinder stop that can cause it to catch.

To correct this problem, use a pair of soft-jawed pliers to screw in the ejector rod (right-hand thread) until it is short enough to swing out the cylinder, then tighten further to prevent it from working loose again.

All later model S&W revolvers (with a dash number after the model number) are supposed to have a left-hand thread which will prevent this malfunction. Other problems follow.

Stop Catches: When the stop catches, the hammer cannot be pulled back in either single- or double-action operation. When this malfunction occurs, many times the point and bevel of the stop have been filed too much —causing the stop to come back into the notch it just came out of, before the hand has a chance to move it to the next cylinder notch. If this happens, install a new stop. The problem can also be caused by an oversize ball which will stick in the cylinder notches. See Fig. 15-27.

Overhaul: If there is no overhaul, the handgun cannot be cocked in single-action operation. A bent spur is one possibility that will cause this problem, especially if the gun has been dropped. Also, look for tape or other foreign matter on the spur, or else the trigger stop may not be in its correct position.

Push off: To check for push off, cock the gun in the single-action position, making certain that the sideplate is in place. Place thumb in back of hammer and then with a normal amount of pressure, push the hammer forward. If the hammer disengages from its cocking notch, you have what is called, "push off."

Push off may be caused by a chipped or broken cocking notch on the hammer, a broken bevel on the trigger, or a point of the bevel not being sharp enough.

It is recommended that no work be done on the hammer. In repairing, all adjustments should be made to the trigger.

Creep: Creep is checked only in the single-action position. This condition will not give a crisp fall off when the trigger is pulled. There will be a little jump off the bevel in the cocking notch, and is sometimes caused by a rough cocking notch or a rough bevel. To repair, try stoning the bevel the same as for a push off.

Hammer block: The hammer block of S&W revolvers is a safety feature in addition to the rebound and hammer seat If the revolver operates better without the hammer block in place, check to see if the hammer block is damaged. It may be bent or burred. Rough edges will also cause problems. Also check to see if the top of the rebound or hammer seat is too low. This will cause the hammer to move too far forward and close the opening for the flag or the hammer block. If the hammer seat is too low on rebound, replace with a new rebound.

Rough cylinder opening: When the cylinder opens or closes hard, one or more of the following may be the reason:

- Loose rod.
- Short or longer center pin on knurled end of rod.
- Yoke out of line.
- Sticky center pin.
- Tight yoke screw.
- Bent or crooked rod.
- Locking bolt may be too big and sticking in rod.
- Short bolt — dirt may be behind bolt in front of the front leg or on the frame.
- Check for long hand.
- Cylinder hits on closing.
- Leaded breech.
- Check for end shake on cylinder and yoke.

Stubs: This is a sear problem. Stubs are only found during double-action operation. This situation is generally caused by too much play between the sear and bevel of the trigger, causing the cam of the trigger to hit the bottom of the cocking notch. This problem can be repaired by installing a new regular sear or a long sear. A long sear may have to be cut so the trigger bevel will return in and under the sear. Letting the sear out too much may cause stubs.

Rough double-action operation: Items to look for when this malfunction occurs are:

- Check for cylinder cramp.
- Loose or bend rod.
- Locking bolt top fitted too tightly.
- Yoke out of line.
- Not enough space between barrel and cylinder.
- Leading around breech.
- Check to see if all pins are down and in place.
- Make sure hand is free.
- Make sure there is no sticky hammer nose.
- Check hammer boss along with trigger boss.

Sear click: Sear click involves the sear and only happens during double-action operation. If the sear has a click or jump in it, this may be caused by an improper angle at the end of the sear. This can be caused also by the sear not being let out enough.

During repair, try to change the angle at the sear bevel or let the sear out by filing the seat as shown in Fig. 15-28.

Stop problems: When a revolver stop sticks, look for the following:

- Stop sticks in notch of cylinder.
- Stop sticks inside frame.
- Stop travels too far below frame.
- Point of stop is too long which causes it to travel below the frame.

When the stop doesn't recover, the hook of the trigger is not getting back into the slot of the stop. It will feel like a "stubber" or stop-catch problem.

To repair a long stop, file the bevel and point of the stop as shown in Fig. 15-29.

Loose rod: This will always cause the cylinder to open hard. First try tightening the rod with the fingers. If this does not help, push the thumbpiece forward to push the locking bolt out. Then take pliers and grasp the locking bolt and pull it toward the muzzle. Now tap the cylinder lightly on the bench. If this also fails to open the cylinder, try pulling back on the hammer until the stop is out of the cylinder notch. At this point, take a piece of paper and slip it between the cylinder and stop. This will allow the cylinder to be turned while holding onto the rod. After the rod has been tightened, always check it for rod "run-out."

Rod run-out is a bent rod and can cause rough extraction. This problem will also cause rough opening and closing of the cylinder. After the rod has been straightened, always check the yoke alignment with the yoke liner.

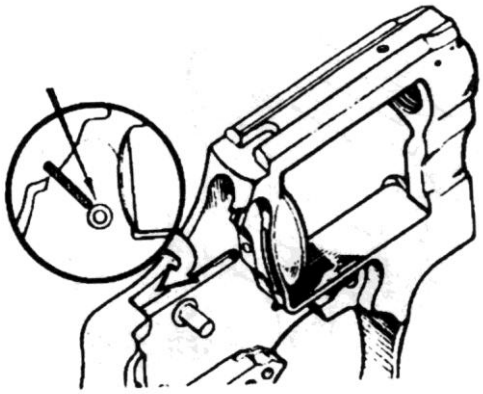


Figure 15-28: Filing the sear bevel to correct sear click.

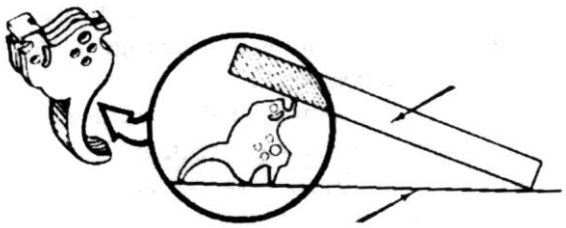


Figure 15-29: Stop bevel points to file to correct stop recovery.

Rough extractor: Check to see if the extractor pins are missing. If lost, replace by fitting through top of the extractor. Also check internal parts of the cylinder.

Rough center pin: This condition could be caused by rod run-out, the rod or its knurled end crushed, or a weak or missing center-pin spring.

Cylinder hits on closing: This condition pertains to the cylinder and yoke end shake. To check, hold the barrel in the left hand with the muzzle facing down. Take the rod in the right hand and close the cylinder until it hits the "ear" of the frame with the center pin. Turn the cylinder and look to see if there is an opening or a space between the barrel and the cylinder. At this point the gun should be checked out for end shake on the cylinder and end shake on the yoke. Also check the breech for lead build up.

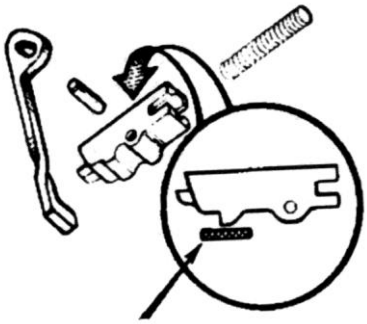


Figure 15-30: Filing the top of the hammer seat can often correct a rough hammer problem.



Figure 15-31: Swaging tool used to correct a binding hammer in S&W revolver.

Rough hammer: Check for sticky hammer nose. Also make sure that the sear pins are flush in position. Check for old or new hammer stud.

Hammer hits bolt: This condition may cause the cylinder not to open. It is usually caused by the tail of the hammer hitting the rear leg of the bolt. Check by pushing the thumbpiece forward to see if it clears the hammer tail.

To correct a rough hammer, file the top of the hammer seat as shown in Fig. 15-30. Too much filing, however, can cause too little space for the hammer block. If too much is filed, a new rebound will have to be installed.

Loose or binding hammer: If the hammer is found to be very loose, the cause could be over-grinding on the hammer. In this case, a new hammer must be installed. If the stud hole is too big from wear, swage the hammer stud hole with a swaging tool (Fig. 15-31), but never over-swage. This could make the hammer bind. Use a tapered reamer to open the hole to correct size.

Hammer hits rebound: This problem may cause misfires. To check this condition, pull trigger back while holding hammer forward; there should be a little play or wink between the front of the rebound and the back of the hammer. If no wink is found, the hammer could hit the front of the rebound, which in turn would hinder the hammer nose from coming through the frame to hit the primer.

To repair, file the front of the hammer seat as shown in Fig. 15-32. After filing, always brake comer with a file and Arkansas stone. Too much wink will prevent the safety feature to operate correctly.

Hammer hits trigger: To check for this condition, while holding hammer back (in single-action operation), release the trigger from the hammer's cocking notch, then gradually move the hammer forward to see if the hammer foot is hitting the cam of the trigger. If this happens, it can impede the trigger return, which can cause misfires.

The hammer hitting the trigger is sometimes caused by the trigger stop on combat S&W models. The same two parts involved in a stubber are involved in the hammer hitting trigger malfunction. Light stoning on the trigger cam will help (see Fig. 15-33), but never stone the hammer. This condition can also be caused by the hammer not cocking fully.

Hammer nose hits: If the hammer nose is bent, this can cause the hammer to hit off center of the firing-pin hole — causing damage to the frame. Bend nose back to its normal position.

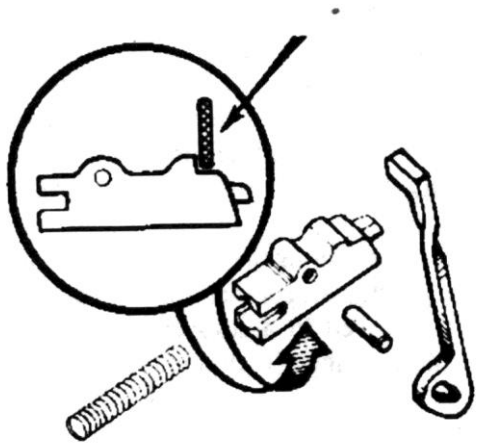
Knuckles (end of spring hits under hammer): This condition is caused when the strain screw has been loosened or filed too much; alternating the mainspring will also cause this condition, and is first noticed in double-action firing when misfires occur.

Check by holding trigger back, and then moving hammer all the way back; notice if hammer has a rough feeling.

To repair, replace the strain screw or mainspring. Tightening of the strain screw may help.

Poor recovery: After a revolver has been fired, it may have a poor trigger recovery. This could be caused by the rebound spring being cut off too much. Also, check to see if the hammer block has room to return in front of the hammer and frame. This problem could be caused by too much filing of the hammer seat, located on the rebound. If so, replace with a new rebound. Also check for recover points on the stop, trigger hook, rebound-friction points, and the sear. Polishing any recover points will help. However, never cut more than two coils off of any rebound spring.

For better double-action operation, hone the cylinder hook located on the trigger.



Flgure15-32: File the front part of the hammer seat to correct a hammer hitting the rebound slide.



Figure 15-33: Light stoning on the cam of the trigger usually helps prevent the hammer from hitting the trigger.

Bolt locks hammer: Check this condition with the gun closed. Push thumbpiece forward, and observe whether it returns to its original position upon releasing thumb pressure. Repeat this check on all chambers. If it will not return on all six, check to see if the rod is running out. Perhaps a sticky locking bolt is the cause, or the yoke may be out of line.

Stop doesn't hold: Using normal pressure, try to lift cylinder off the ball of the stop; it should not lift off for correct functioning. Sometimes this condition exists only on one cylinder notch. To correct, file the top of the stop as shown in Fig. 15-34.

Hand sticks: Spin cylinder and see if gun "sings." The hand could be sticking in the hand slot, or the hand may be disengaged from the torsion spring. Also check for build up of lead, carbon, or other foreign material in the hand slot in the frame.

Long hand: This condition will cause the cylinder to close hard. Check to see if throat of hand is up above the face of the frame. If so, file the hand throat until it is flush with the frame. However, be careful not to file the hand too much; a short hand will not pick up the cylinder to turn it.

Shaving lead: When the revolver shaves lead, check for loose cylinder stop, a loose locking bolt, the space between the barrel and cylinder, and for any lead build up in the cone. Also make sure the yoke is property aligned.

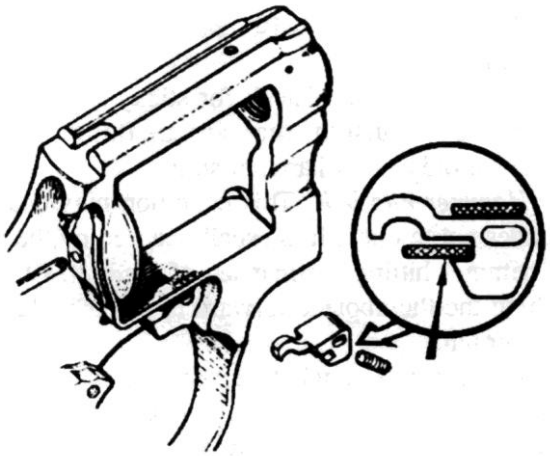


Figure 15-34: Filing the top of the revolver stop can correct a nonholding stop.

Chapter 16 - Semiautomatic Pistols

Semiautomatic pistol actions are divided into two systems based on the method operating the action. The types that use low-powered rimfire and centerfire cartridges usually utilize a blowback system. This is the same method as discussed in Chapter 6 on semiautomatic rifles; that is, the pistol does not use a locking mechanism to hold the breechblock in place. Instead, the weight of the breechblock and the power of the recoil spring keep the breech in place while the pistol is being fired.

The slide on an automatic pistol can extend over the barrel, as in the case with the ·45- and ·32-caliber Colt, or the slide can extend toward the rear of the receiver with the barrel remaining stationary as with the Colt Woodsman and similar rimfire pistols.

Other semiautomatic pistols that incorporate a slide extending over the barrel operate off of a breechblock or delayed blowback system. These pistols are the more powerful pistols, such as the ·45 Colt, using centerfire ammunition. With this system, the barrel and breech travel rearward for a short distance while they are attached; then they separate after the bullet has cleared the muzzle. The slide completes its trip to the rear of the gun, allowing the spent casing to be ejected and, as the slide returns, to pick up a new cartridge. When the breech contacts the barrel, they lock together and the pistol is ready to fire again.

Other types of semiautomatic pistols include the short-recoil design, or a combination of short recoil and blowback systems. These pistols operate and complete all functions of firing in the same way as automatic rifles. After chambering the first round manually, all that is required of the shooter from then on is trigger pressure. The gun completes all the other functions automatically, and will continue to fire until the magazine is empty.

Possibly one of the most familiar semiautomatic pistols is the Colt ·45 caliber Models 1911 and 1911A1 —the types used by our armed forces for over 50 years; it was just recently that our Government decided to drop the Colt for a design introduced by a foreign manufacturer, chambered for the 9mm Parabellum!

The Model 1911 is very dependable in operation and almost jam-proof in its various refined versions. Furthermore, it bows to no other for the accuracy demanded by competitive target shooters. The secret of accuracy in the Colt ·45 semiautomatic pistol is in the bushing, or barrel sleeve, through which the barrel moves back and forth when firing, returning the barrel to the same position after each shot.

The Colt Model 1911 is a short-recoil design and, after firing, the barrel and receiver travel to the rear together for about ⅜″, then the barrel unlocks from the rest of the recoiling mechanism and the action is opened. The barrel, which is attached to the receiver by means of a small, oval-shaped pivoting link, is arrested in its rearward travel down and away from the slide as the slide proceeds to the rear. Once the barrel stops, the slide —in its rearward movement — extracts the fired case from the chamber and then the case is ejected out of the gun by an ejector mounted at the top left rear of the frame.

When the slide is in its most rearward position, the hammer is cocked and the disconnector is depressed. This slide position also allows the magazine spring to force a new cartridge up in line with the breech so that the slide — on its forward movement — strips this cartridge from the magazine and feeds it into the chamber. In its forward movement, the slide also engages the barrel and moves it forward and upward, pivoting on the oval link attached to the frame. The barrel is then cammed so that two ribs, cut at right angles to the axis of the barrel, engage recesses milled in the top of the slide — locking the action. The gun is now ready for firing. See Fig. 16-1.

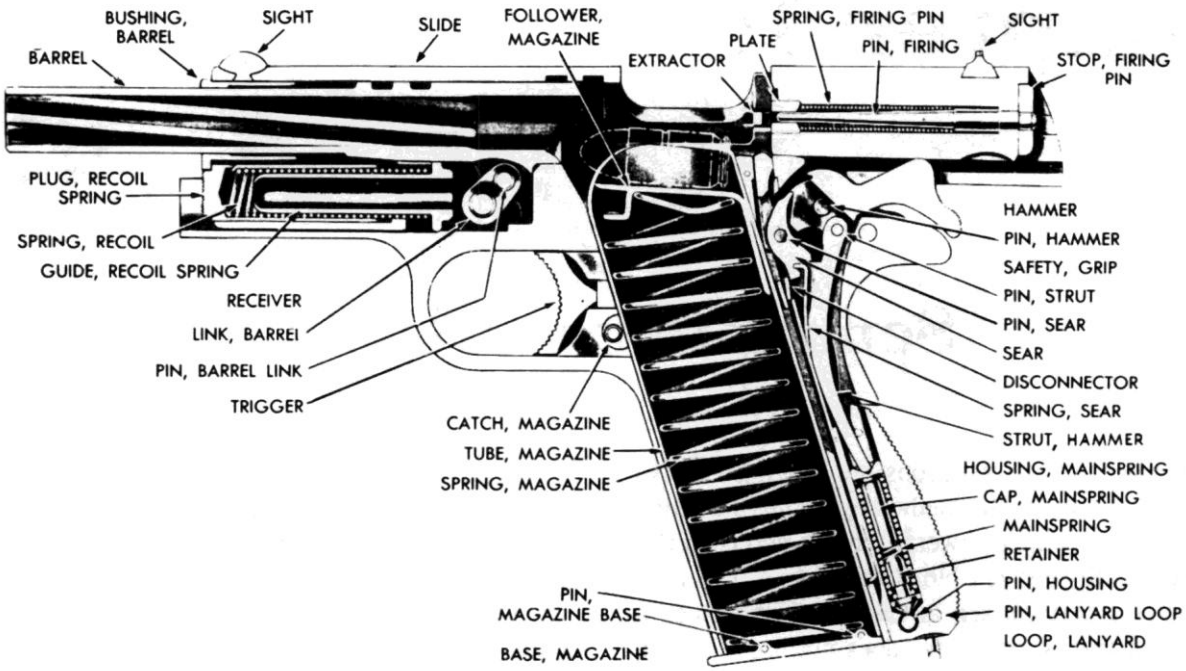


Figure 16-1: Sectional view of Colt Model 1911 semiautomatic pistol.

Troubleshooting Semiautomatic Pistols

Semiautomatic pistols should receive regular inspections to keep them in perfect operating order. Most of the repairs can be accomplished with a gun-cleaning kit and a set of Arkansas stones.

When a Colt ·45 Model 1911 comes into the shop for repair, initial cleaning and inspection should be the first steps taken. Inspect the receiver housing for excessive wear or burrs in the slide mating grooves and also for deformation. Check to see that the plunger tube, ejector, and stock-screw bushings are not loose, burred, or excessively worn. Check the mainspring housing mating grooves in the receiver and the trigger groove for burrs. Check the slide-stop notch for oversize or excessive wear.

Continue by checking the half-cock position notch on the hammer for cracks, chips, or excessive wear. Also be certain that the hammer strut is not bent or cracked. Then continue with the following checks:

- Inspect the sear spring for broken leaves and tension.
- Inspect the sear for a worn or chipped tip or excessively worn lugs.
- Inspect the disconnector for burrs or excessive wear.
- Inspect the trigger for burrs and deformation.
- Inspect the safety grip for burrs and excessive wear, or cracks on the tip that engages the trigger.
- Inspect the mainspring for weakness or breakage.
- Inspect the mainspring cap, housing pin retainer, and housing pin for excessive wear.
- Inspect the mainspring housing for burrs on the mating surfaces.
- Inspect the stocks for cracks or worn checkering.
- Check the trigger pull and, if too heavy, hone the mating surfaces of the sear and hammer until they meet squarely.

Malfunctions such as jams and failure to feed, extract, and eject are some of the problems that will be encountered in semiautomatic pistols. Use the same tools as mentioned earlier in this book.

In many cases, a good cleaning is all that is required to put an ailing semiautomatic pistol back into shooting condition, although other problems — requiring more time — will also be encountered.

Failure to feed: When a semiautomatic pistol fails to feed, the first step is to clean and polish the chamber with a brass brush, as a dirty or badly fouled chamber is the primary cause of jams and hang-ups in semiautomatic pistols.

If feeding problems persist after the chamber is polished, check the magazine for dents, weak springs, etc. Should the magazine be found defective, replace it with a new one if at all possible. The time required to straighten a magazine or remove dents can be very time-consuming, costing more than a new magazine. However, you might want to try honing the inside of the feed lips. Oftentimes, these lips become burred and cause jamming; smoothing them up will often solve the problem. Of course, a broken spring should be obvious and should be replaced. If the spring is bent or rusted, it also should be replaced.

Still no luck? Then examine the feed ramp; a badly fouled or burred feed ramp may be causing the trouble. Use a wire brush saturated with bore cleaner to scrub the ramp and free it from all fouling. Then use a piece of crocus cloth wrapped around a small wooden dowel to polish the ramp bright. A moto-tool with a polishing head is ideal for this, but do not change the contour of the ramp when polishing with power tools. If the ramp is badly burred, an Arkansas stone (round) or a half-round file should be used to remove the burrs before polishing. Burrs in the chamber will also cause problems, but these should have been removed during chamber polishing.

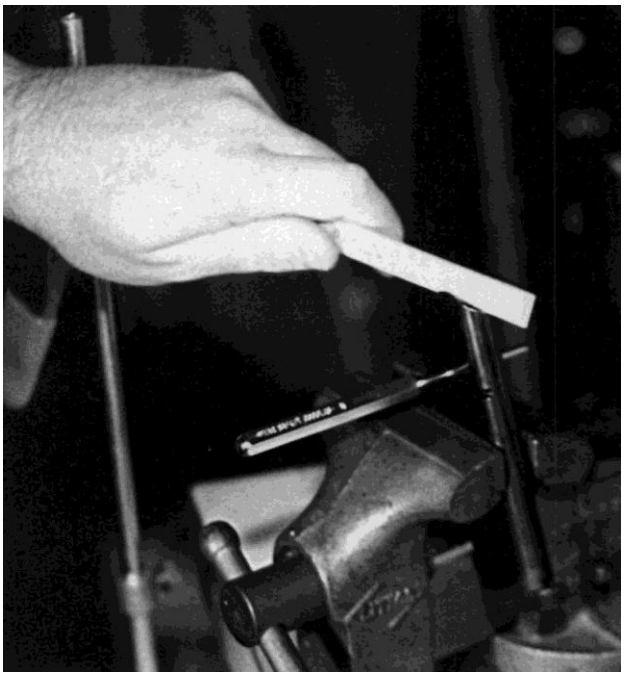


Figure 16-3: Honing the inside of the feed lips on the Model 1911 Colt 45. Note that a drift punch is used to depress the magazine spring and follower.



Figure 16-2: This group of tools will handle the majority of handgun repairs.

Failure to extract: The most common reason for extraction problems in a smallbore pistol (·22 rimfire) of blowback design is a dirty chamber. Cleaning it will solve the problem. However, in centerfire pistols — like the Model 1911 Colt — a weak extractor is almost always the reason for poor extraction. To test an extractor, place an empty case under the extractor claw so that the case is flush against the bolt face. Move the slide back and forth along the frame — not closed, but just an inch or so each way. If the shell case falls out or if it can be easily jiggled out, the gun has a weak extractor and should be replaced.

Failure to eject: An ejector for Browning-type pistols needs sharp edges to function property (Fig. 16-5). Grip the head on the cartridge case securely. Anything less will result in poor ejection, with hang-ups an almost certainty. If, upon examination, the shoulders or edges of the ejector look rounded or contain burrs, use a small flat file and restore the ejector to its proper shape.

Failure to fire: Headspace problems and grime on the face of the pistol bolts are two sure ways to cause a semiautomatic pistol to misfire. A broken or burred firing pin, or a broken, bent, rusted, or dirty firing-pin spring, can also cause misfires. Disassemble the firing-pin mechanism and thoroughly clean all parts prior to inspecting them for wear or damage. The firing pin and firing-pin spring may then be examined under a magnifying glass if necessary. Worn or damaged parts should be replaced if possible.

On ·22-caliber blowback actions, dirt may prevent the bolt from closing completely on the cartridge. Then when the hammer falls, the cartridge is pushed forward and away from the pin, resulting in a misfire.

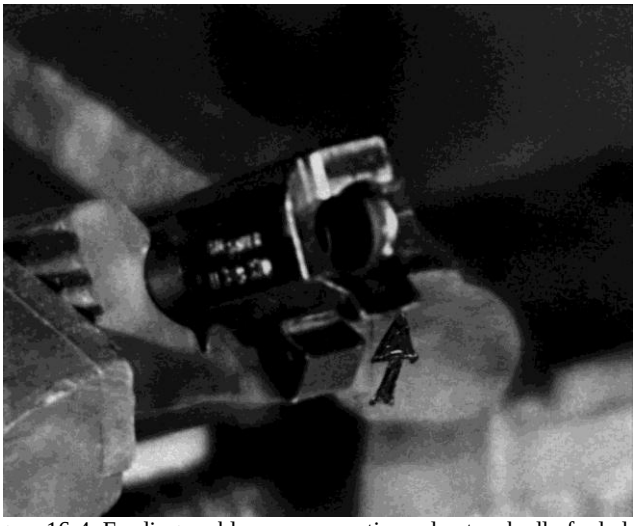


Figure 16-4: Feeding problems are sometimes due to a badly fouled or burred feed ramp.

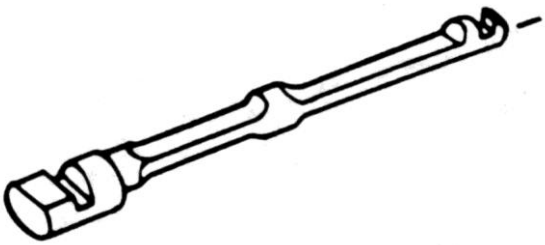


Figure 16-5: Ejector for Colt Model 1911 must have sharp edges to function properly.

Adjusting Trigger Pull

The trigger on a firearm, when pulled, releases the firing pin to ignite the cartridge primer. But did you know that this part was originally called “the tricker,” because when pulled it “did the trick?”

For best accuracy, triggers are not pulled. Rather, ever-increasing pressure is applied until the sear is disengaged, allowing the firing pin to fall against the cartridge primer, which in turn ignites the powder to push the bullet out of the muzzle. Furthermore, effective trigger squeeze requires proper follow-through, avoidance of the natural inclination to jerk or flinch at the moment the sear is released, so that disturbance of the gun (and consequently the aim) by abnormal finger movement is avoided. Therefore, trigger squeeze is very important for obtaining the best accuracy. Just as important is the trigger pull, the distance and pressure required to move the trigger enough to release the sear.

The adjustment of trigger pull is a job that many gunsmiths frequently encounter, and is one which every potential professional should learn as soon as possible.

Semiautomatic pistols such as the Colt ·45, Browning, Star, Savage and others can have their trigger pull improved, but care must be taken in this area when altering the trigger. If a very delicate trigger pull is obtained, a jar of the action may cause the hammer to follow the slide, resulting in an automatic-firing weapon which is both dangerous and illegal.

Trigger sears and hammers on automatic pistols are honed in a similar way as described for the firing mechanism on shotguns and exposed hammer rifles. But after the adjustment has been made, the pistol should be tested by cocking the hammer and, with the finger off the trigger and the grip-safety compressed, drawing back the slide and allowing it to slam forward several times as violently as possible. If the hammer follows the slide (fails to stay cocked) the pull is obviously too light.

A light pull can sometimes be corrected by increasing the tension on the sear spring by bending it, but in most cases, it is best to order a new hammer and sear and start over. For this reason, take great care in honing these parts of the automatic pistol to avoid making this mistake.

Automatic pistols with no hammer exposed usually have a sear which engages a shoulder or notch in the plunger or firing pin. Most of these weapons have a mean, dragging pull, which in some constructions cannot be overcome, owing to the leverage employed in the design. In other types, it can be somewhat improved by carefully honing the contact surfaces so that they will slide evenly and smoothly. In general, the depth of contact or the angle of the surfaces should not be changed, as in many automatic pistols — especially of foreign make — the safety only prevents the digger from being pulled, but will not prevent the sear from jarring out of engagement with the firing pin in case the gun is dropped. When these pistols are loaded they are always cocked, and to alter the sear or firing pin might render the pistol extremely dangerous to carry loaded. For this and other reasons, it is good practice never to load a round into the chamber of an automatic pistol until the gun is ready to be fired. Just slide the magazine into its place in the grip, but do not chamber a round. When firing is completed, unload the pistol, and make sure no round is in the chamber.

Trigger pulls on semiautomatic pistols should never be lower than four pounds for safety reasons, nor more than six pounds for the sake of accuracy. In most cases, trigger pull crispness and creep can be improved by honing the mating surfaces of the sear and hammer until they meet squarely. Use a hard Arkansas stone and draw the stone lightly across the hammer notch contact surface a few times. Then secure the sear in a vise and smooth the bearing surface with a few strokes of the stone. Don't remove too much metal and be sure to keep the surfaces square (Fig. 16-6). Note that the sear on the right is rounded and the notch is undercut too far; the one on the left is correct.

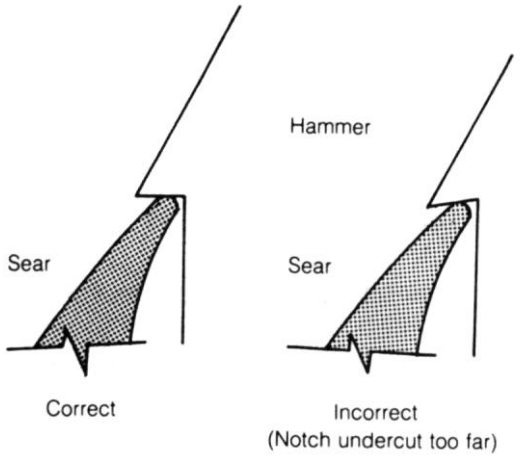


Figure 16-6: Correct and incorrect angle for the sear/hammer mating surfaces.

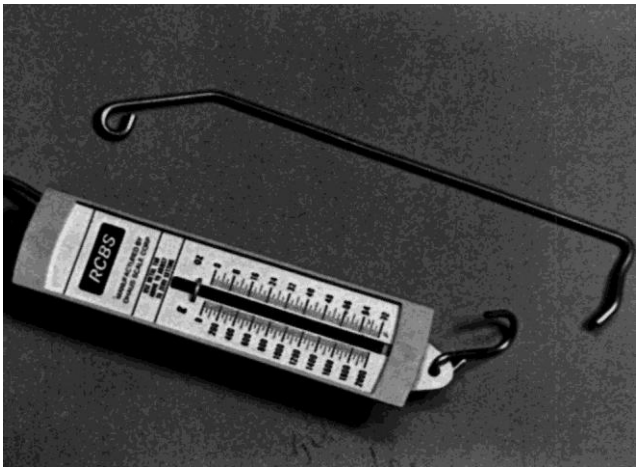


Figure 16-7: The RCBS Trigger-Pull Gauge provides a direct reading in both ounces and grams. A heavy-duty steel trigger hook is included to adapt it for rifle, pistol, or shotgun.

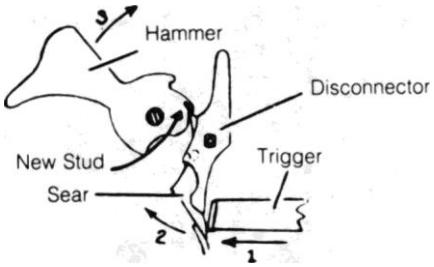


Figure 16-8: Method of adjusting trigger pull when too much metal has been removed from the sear/hammer mating surfaces.

Another way to correct trigger pull on autoloading pistols is to weaken the mainspring. In most of these pistols, the mainsprings are much stronger than required for proper functioning of the weapon, causing excessive trigger pull. By cutting a couple of coils from this spring, a lighter trigger pull may be obtained and accuracy will be improved. Start with a half coil at a time and work slowly. Remember, you can't replace a coil from the spring once it has been removed. If this technique is used, never take off more than three coils from the mainspring.

Remove the mainspring from the gun and remove a half coil. Refit the spring and try the pistol with a trigger-pull gauge (Fig. 16-7). Also check the gun for proper functioning under actual fire. Continue this operation until a limit of four pounds of trigger pull is acquired. If you should accidentally go one-half coil too much, the mainspring can be stretched slightly to compensate for this half turn — but not much more.

Trigger adjustments should not be taken lightly; great care should be exercised. For example, lightening a mainspring too much will decrease the tension between the sear and the hammer to a point where the gun will not fire. Take too much metal from the sear and hammer mating surfaces and you'll have a pistol that will possibly fire automatically or have such a hair trigger that the gun will discharge almost by looking at it.

Another component that should be polished to improve trigger pull is the disconnector. This part has a beveled surface on one of its lower sides and a flat surface on the other. The beveled edge engages the center leaf of the sear spring while the flat edge contacts the trigger stirrup. These surfaces should be polished with a crocus cloth. Go lightly! Too much polishing can cause a dangerous and unreliable arm.

If a semiautomatic pistol is encountered with too much metal removed from the sear and hammer mating surfaces, it is sometimes possible to correct this (without buying a new part) by drilling a small hole just below the hammer notch where it contacts the sear (Fig. 16-8). Drift a small but oversized length of steel rod into the hole, creating a stud or projection that serves as a sear stop while limiting the engagement area between the sear and the notch. If the stud projects too far, making the trigger pull too light, the stud can be filed down which will increase the contact surface and heavy up the pull weight. The troubleshooting chart in Fig. 16-9 will prove helpful for correcting problems in semiautomatic pistols of all types.

TROUBLESHOOTING CHART
Semiautomatic pistols

Malfunction	Probable Cause	Corrective Action
Misfires	Broken or bent firing pin	Replace
	Weak mainspring	Replace
	Excess headspace	Replace barrel
	Defective cartridge	Check ammunition
Fails to extract	Broken extractor	Replace
	Rough chamber	Polish chamber
	Short recoil	Slide interference
Magazine falls out	Worn or broken magazine catch	Replace
Hammer won’t cock	Broken sear or broken sear spring	Replace
	Broken hammer notch	Replace hammer
	Wrong sear angle	Replace sear and hammer
Hammer won’t fall	Broken sear bar	Replace
	Disconnector jammed	Inspect and clear
	Sear jammed	Inspect and clear
	Foreign material in action	Clean
Jams	Excessively dirty chamber	Clean and polish
	Piece of cartridge case mouth stuck in chamber	Remove and polish chamber
	Bent recoil-spring guide or battered abutment in frame	Repair guide

Figure 16-9: Troubleshooting table for semiautomatic pistols.

Appendix I - Service Manuals

Manufacturers of most American-made firearms provide parts lists and takedown instructions for each. This information is very useful to the gunsmith, especially if a certain model has never been encountered before. Many of these same manufacturers also have service manuals for their various models which give specifications, principles of operation, assembly/disassembly instructions, and most important, troubleshooting and repair techniques.

You should start accumulating all of the literature that is currently available. Furthermore, you should keep it arranged so it is readily available when the need arises. Filing cabinets are ideal, but cardboard boxes will suffice. Just make sure you file the literature so you can find what you need without going through the whole pile; that is, arrange the material in alphanumerical order, first by manufacturer, then by model number.

Manufacturers' service manuals range in price from $1.00 to perhaps as high as $50 each. However, some of this literature is often free. Now would be a good time to inquire as to the availability and price of their service manuals and parts catalogs.

The following is a list of the major firearm manufacturers and importers in the United States, and where to write to obtain information on availability and price of service manuals. Manuals for some firearms are out-of-print and no longer available. All manuals are usually shipped postage paid, but C. O. D.'s are not accepted in most cases. You will have to allow 20 to 60 days for delivery.

Out-of-print service manuals should also be obtained when they can be found. Finding them, however, might not be easy. Look for other gunsmithing firms that are going out of business. Chances are such firms will have piles of old gun catalogs and service manuals — often at a very affordable price. You can also try advertising in the want ads in the shooting publications as *Gun List and Shotgun News*. An inexpensive ad in a local weekly newspaper may also turn up some of these publications.

Beretta U. S. A.
17601 Beretta Dr.
Accokeek, MD 20607

Browning
RL 1,
Morgan, UT 84050

Charter Arms, Inc.
830 Sniffens Lane.
Stratford, CT 06497

Colt Firearms Co.
P. O. Box 1868
Hartford, CT 06101

Daisy Manufacturing Co., Inc.
P. O. Box 220
Rogers, AR 72756

Interarms Ltd.
10 Prince St.
Alexandria, VA 22323

Ithaca Gun Co.
Route 34B
King Ferry, NY 13081

Marlin Firearms Co.
100 Kenna Drive
New Haven, CT 06473

O. F. Mossberg & Sons, Inc.
7 Grasso SL
No. Haven, CT 06473

New England Firearms Co., Inc.
Industrial Rowe
Gardner, MA 01440

Remington Arms Co.
1007 Market St.
Wilmington, DE 19898

Savage Industries Inc.
506 Spring St., Unit E
Westfield, MA 01085

Smith & Wesson, Inc.
2100 Roosevelt Ave.
Springfield, MA 01101

Strum, Ruger & Co., Inc.
Lacey Place
Southport, CT 06490

Thompson/Center Arms
Farmington Rd.
P. O. Box 5002
Rochester, NH 03867

U. S. Repeating Arms Co.
P. O. Box 30-300
New Haven, CT 06511

Weatherby's
2781 E. Firestone Blvd.
South Gate, CA 90280

Winchester Repeating Arms Co. (See U. S. Repeating Arms Co.)

Appendix II - Custom Gunsmithing Tools

Chapter 2 of this book described the basic tools needed to perform gunsmithing work. However, there are many specialized tools that will make the gunsmith's work go easier. Most of these were initially invented by practicing gunsmiths in private practice or those working for the various firearm manufacturers. Eventually, they were shared with other professionals, and once the word got around, several of these custom tools are now offered to the trade.

Here is a sampling of some tools that should prove useful in troubleshooting and repairing certain firearms. Further custom-made tools may be found in the pages of American Gunsmith.

You will also probably devise special tools of your own — to facilitate your particular type of work. Remember, the right tool for the job can save hours of your time. So, any tool that is used frequently is cheap at any price.

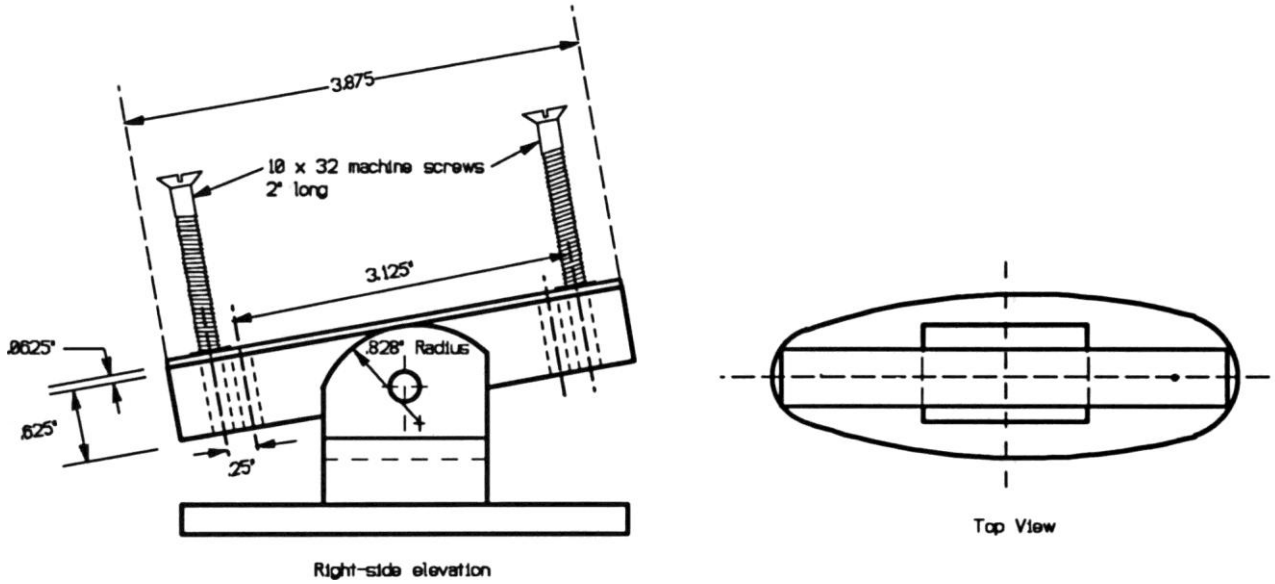


Figure APII-1: Recoil-pad jig to facilitate the installation of recoil pads on gunstocks. It may be built from the plans on this page and the page to follow, or purchased from Brownells Inc.

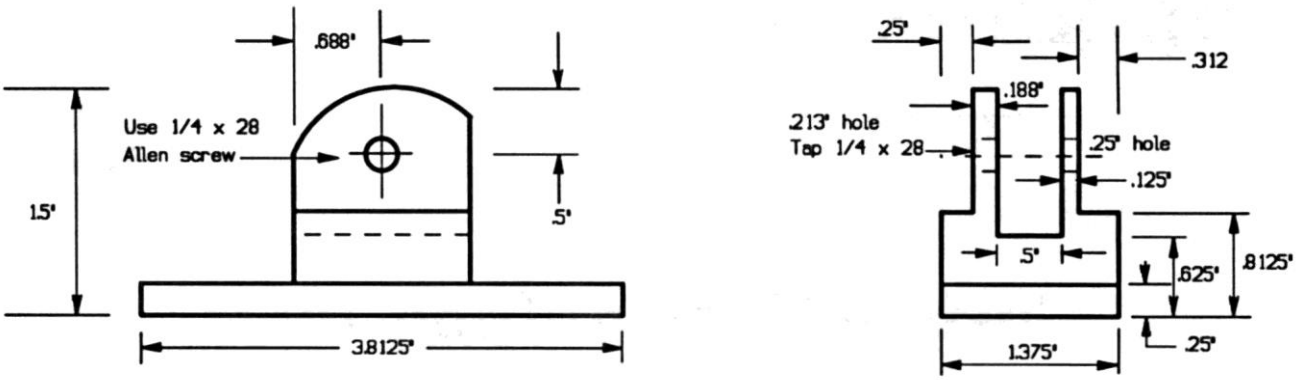


Figure APII-1: Base for recoil-pad jig shown above.

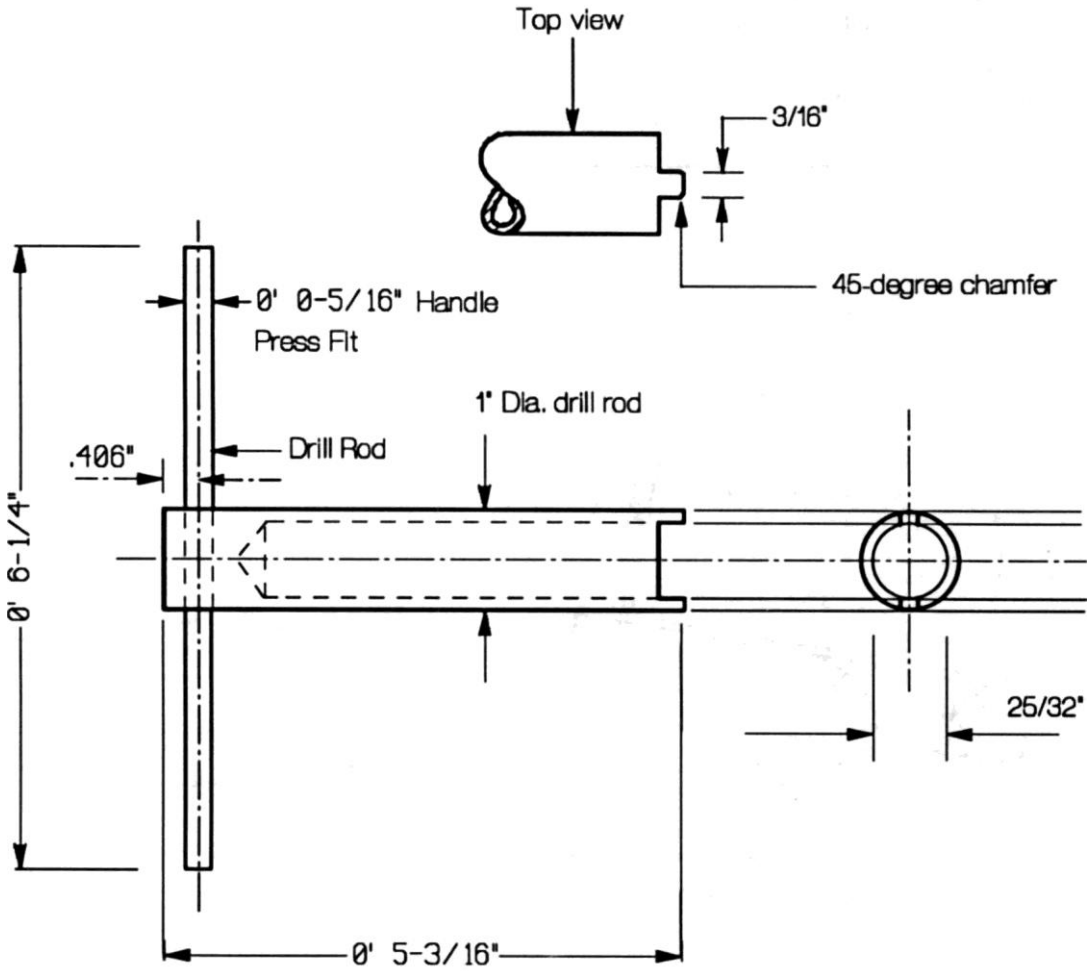


Figure APII-2: Remington Model 760 forend nut wrench.